SCIENTIFIC AMERICAN

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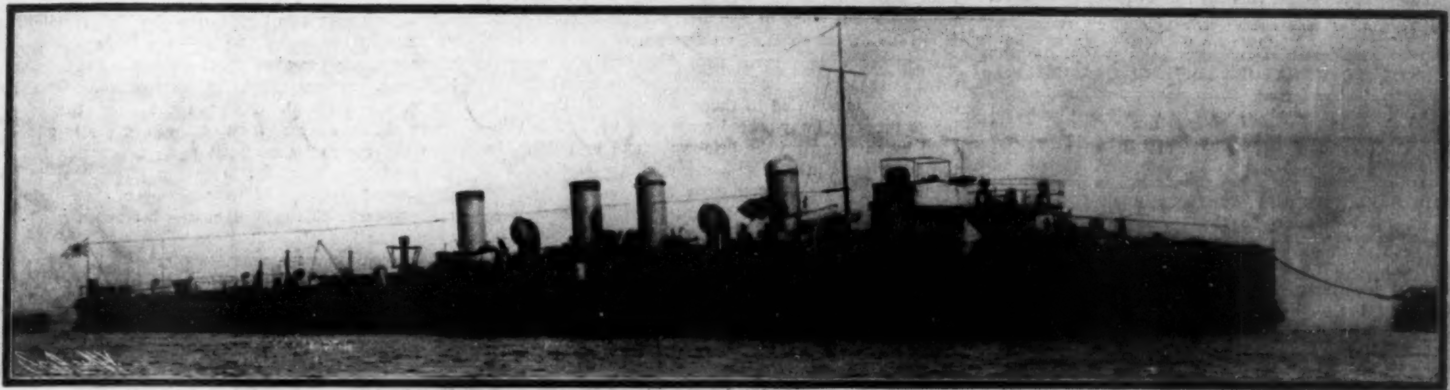
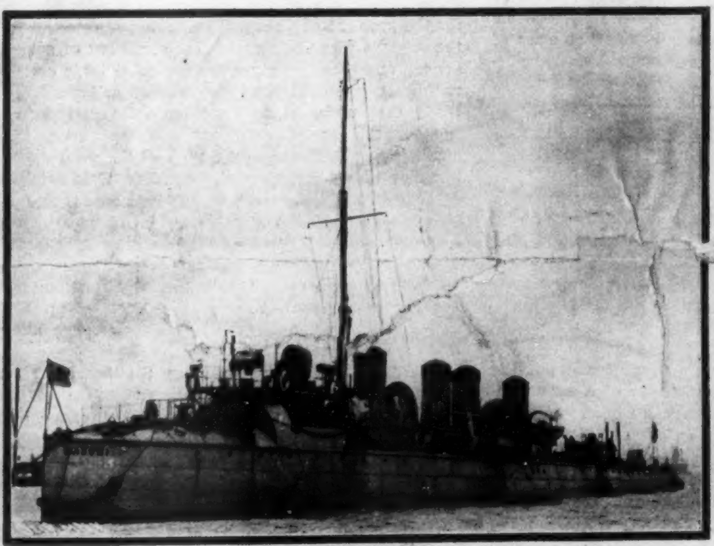


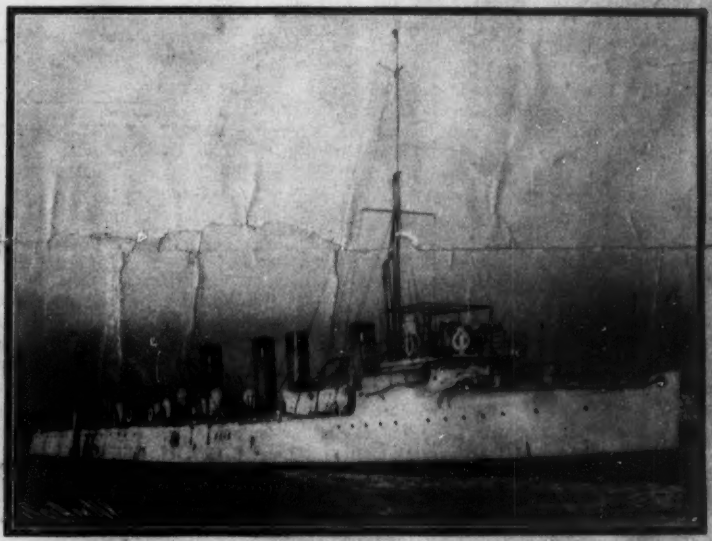
Length, 220 feet. **Beam,** 20.6 feet. **Draft,** 9.6 feet. **Displacement,** 360 tons. **Speed,** 31 to 31.4 knots. **Armament:** One 3-inch; five 6-pounders; two 18-inch torpedo tubes. **Builder,** Yarrow. **Date,** 1899.

"Sazanami." Class of Four Destroyers.



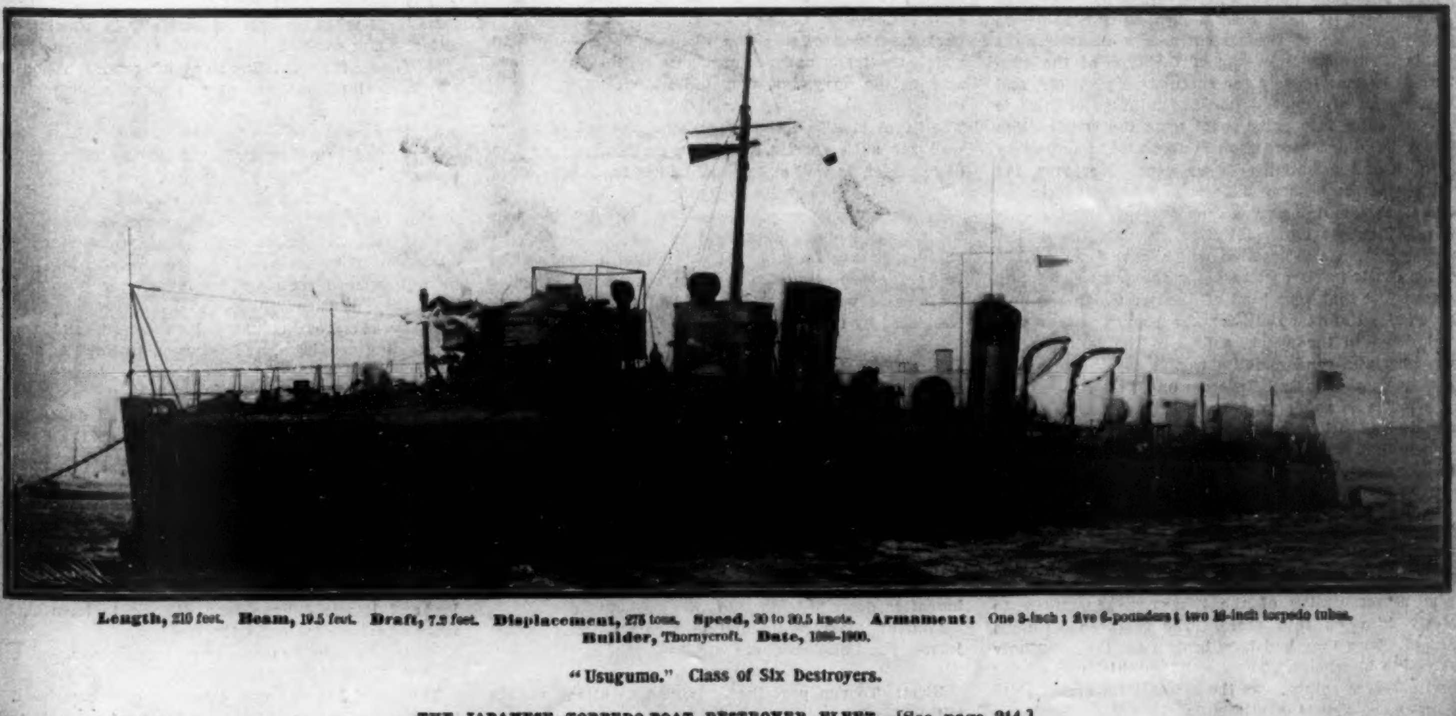
Length, 220 feet. **Beam,** 20.6 feet. **Draft,** 9.6 feet. **Displacement,** 360 tons. **Speed,** 31 knots. **Armament:** One 3-inch; five 6-pounders; two 18-inch torpedo tubes. **Builder,** Yarrow. **Date,** 1902.

"Kasumi." Also "Katsuki."



Length, 216.7 feet. **Beam,** 20.7 feet. **Draft,** 8.3 feet. **Displacement,** 300 tons. **Speed,** 31 knots. **Armament:** One 3-inch; five 6-pounders; two 18-inch torpedo tubes. **Builder,** Thornycroft. **Date,** 1901-1902.

"Shirakumo." Also "Asashio."



Length, 210 feet. **Beam,** 19.5 feet. **Draft,** 7.2 feet. **Displacement,** 275 tons. **Speed,** 30 to 30.5 knots. **Armament:** One 3-inch; five 6-pounders; two 18-inch torpedo tubes. **Builder,** Thornycroft. **Date,** 1898-1900.

"Usugumo." Class of Six Destroyers.

THE JAPANESE TORPEDO-BOAT DESTROYER FLEET.—[See page 214.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, MARCH 12, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE DARLINGTON APARTMENT HOUSE DISASTER.

The fatal disaster to the Darlington Apartment House, in which, at the present writing, over fifteen persons are known to have lost their lives, is one more of those ghastly tragedies which seem to be necessary to stir up the public conscience to the point at which it sets resolutely about the removal or correction of some menace to the security of life and property. The stolid inertia of public opinion can be overcome apparently only when life is sacrificed by wholesale. Then we wake up; demand reforms; and to some extent get them. For proof of this it is not necessary to go beyond a radius of a quarter of a mile from the spot where they are at the present moment taking out the unfortunate victims of willfully careless tall building construction. Not much more than a stone's throw away is the site of the Windsor Hotel tragedy, the inmates of which offered their lives as the purchase price of a thoroughly drastic investigation of the question of fire-escape conditions in this city. Matters are better now than they were before the Windsor Hotel fire. At least, we hope they are. Within a stone's throw of the Windsor Hotel site one may climb down into the tunnel of the New York Central Railroad Company, and on the easterly wall thereof, he will see the deep scars on the brickwork, which were made as the wreck of a coach, in which some score of unfortunates were crushed out of existence, was driven forward by the colliding engine. It needed apparently the sacrifice of twenty prominent business men of this city to set in motion the public sentiment which, in its turn, is bringing reforms in railroad management which will abolish forever the likelihood of a similar disaster.

The pile of wreckage with its entombed victims on West Forty-sixth Street teaches nothing new. Long before the falling of the building it was suspected that a considerable amount of "jerry" work was being done on the "bastard" steel structures, which are being run up continually in this city. We use the term "bastard" advisedly; for a structure that extends ten stories in height and depends for its rigidity upon the lugs and flanges of miserable, little, rectangular, cast-iron columns, has no rightful claim to the reputation for strength and security that goes with the term "steel construction." It was merely a question of time before on one or other of these structures a disaster such as this occurred. Buildings of the type of the Darlington are built purely for speculative purposes, and not a pound of material nor five minutes of time is going to enter into or be spent upon the construction of such buildings, more than is absolutely required by the laws of the Building Department. Moreover, the evidence of the building inspectors proves that in the case of this building, and doubtless of many others like it, there is a persistent effort to evade those rules of construction and erection which have been framed by the Building Department for the purpose of preventing just that very kind of disaster which has now happened. Unfortunately for the poor wretches who went down in the wreck, a flaw in the Building Department laws renders it impossible for the inspector to immediately stop construction on discovering faulty work. The law's delay between the making of such protests by the inspector and the stopping of the work is such that a contractor has some two weeks' grace before an injunction can be served.

As to the immediate cause of the wreck, it will be difficult to pronounce definitely until something more than a superficial examination can be made; but speaking broadly, it may be put down at once to faulty construction. It took but a single glance at the building by a representative of the SCIENTIFIC AMERICAN to satisfy him on this score. The cast-iron columns showed where they had been broken off, the seemingly inevitable blowholes. The maximum thickness of the shell of these columns at the street level appeared to be no more than the minimum allowed in any cast-iron column used throughout the whole building. There is a sudden decrease in the section of the cast-iron columns of the front wall of the building from 10 or 12 inches at the street level to 6 inches on the first floor. What this line of columns had been reduced to by the time it reached the tenth floor is a matter of interesting conjecture. The connections appeared to have been all bolted, not a rivet being visible in the wreck of the iron and steel work.

We are of the opinion that the cause of the collapse was the lack of proper sway-bracing to keep the structure in its true perpendicular position, coupled, probably, with eccentric loading. The crying evil of cast-iron column work, especially in a building of this kind, where the bending moments are very severe, is, that the whole work of resisting the bending, or what might be called shutting-up stresses of the steel and iron skeleton, is thrown upon the cast-iron connections at the columns, and upon the bolts by which the floor systems are tied to these columns. If the building is properly sway-braced as it goes up, and is stiffened by carrying up the brickwork and by putting in the concrete or tile floors close upon the heels of the erecting gang, the stresses upon these connections may be kept down within safe limits; but where, as in this case, the haste, carelessness, ignorance, or greed of the contractor led him, in direct defiance of the warnings of the Building Department, to carry the steel and ironwork up far in advance of the brickwork, etc., and without putting adequate sway-bracing in this lofty work, it becomes easily possible for the stress upon the cast-iron connections to exceed the breaking strength, and precipitate a disaster.

The lessons to be learned are, first, that the building inspectors should be given the necessary authority to stop work on the instant, or at least within an hour or two, of their discovery of faulty and dangerous construction; and, secondly, that the limit of the height of building in which cast-iron columns are permissible should be greatly reduced, especially for that class of structure which is put up merely for speculative purposes.

REPORT OF THE ARMY BOARD AS TO THE USEFULNESS OF THE LAKE TYPE OF SUBMARINE BOAT FOR COAST DEFENSE.

Some weeks ago, in our issue of December 26, 1903, we published an account of the submarine torpedo-boat "Protector," designed by Mr. Simon Lake. At the time the vessel was lying at Newport, R. I., awaiting trial by a naval board, but owing to ice in Narragansett Bay on January 12—the day set for the beginning of the trials—the board temporarily abandoned its work. A week later, with the water and weather conditions even more trying, an army board put the vessel through a series of maneuvers of a most convincing nature. The immediate result of the military examination of the vessel was an official report recommending the purchase of five submarines of the Lake type. That report, in turn, was referred to the General Staff of the army, and the General Staff has now added its confirmation to the recommendation of the examining board.

The examining board was composed of officers of the artillery corps, which now has control of the country's submarine coast defenses. These officers were Major Arthur Murray—senior officer of the School of Submarine Defense at Fort Totten, N. Y.—and his associates, Captains Charles J. Bailey and Charles F. Parker. These officers had likewise been detailed to watch the trials and performances of the submarines now in the navy, but they did not find those boats susceptible of military adaptation for coast defense. The "Protector," on the other hand, seemed to augur well for such service, and her performance on the day of trial, as well as the well-known sea-going record of the craft, are substantiation.

The military aspect of the question is summed up in the following particulars cited by the board; and, in passing, it may be said that this military view of the field of usefulness of the Lake submarine is quite coextensive with the widest field of service now contemplated by the navy.

FOR DEFENSE.

First: To take the place of fixed mines, by lying adjacent to the forts and attacking vessels attempting to reduce the works or to run past, particularly in important channels where it is impracticable to plant mines, owing to deep and rough water, extreme width, or the swiftness of currents.

Second: To supplement fixed mines, by attacking vessels approaching the mine fields or those which have crossed them.

Third: To lie outside mine fields for scouting or picket duty, keeping in telephonic communication as hereafter described.

Fourth: To pick up and to repair defective cable joints, junction-boxes, etc.

FOR ATTACK.

First: To run past the forts, and to attack vessels within the harbor.

Second: To drag for, pick up, and to cut multiple and branch cables on the bottom, or mine cables leading to buoyant mines or buoys.

Third: To sweep the channel, two submerged boats being connected by a light cable extending across all or a part of the mine field.

To a very large extent, the board's attention was centered upon the diving compartment. This compartment is located in the bow of the craft, and is separated from the crew-space lying immediately abaft by an air-lock; and both the diving compartment and the air-lock are fitted with air- and water-tight doors. The compartment is fitted with a connection to the low-pressure air system, and provided with a telephone communication with the living space, and a hydro-pneumatic gage with two hands, one of which registers the pressure of the water outside—due to depth—and the other the air pressure in the compartment. At the bottom of the compartment is an iron door, which can be opened outward. To open the door, the air-lock doors are first closed, and compressed air is admitted into the compartment until the gage hands indicate unity of air and water pressures. The door is then unfastened and allowed to swing open, thus giving, in clear water with the boat on the bottom, a good view of the sea bed.

This compartment provides for:

1. Mine cable cutting; or else repair of, or the burying of, mine cables and junction-boxes.
2. A channel for telephonic communication with the shore when the boat is on picket duty.
3. A way of escape for the crew, in case of the total disablement of the boat.

The board, remarking upon the ability of the "Protector" to run under gasoline propulsion with only the observing instrument and sighting-hood above water, said: "By reason of an automatic induction valve in the top of the sighting-hood, admitting air for the gasoline engines and excluding spray and water, the engines may be used in this condition of submergence; and this fact gives to the boat a large cruising radius at comparatively high speed, and renders it likely that under many conditions of sea, light, and weather, the craft may get within torpedo range without being seen, in the event even of the total disablement of her electrical equipment. In this condition, of course, the omniscope would be housed, and the sighting-hood, of a neutral color, could be discerned only with great difficulty. This ability of the boat to run under gasoline propulsion almost entirely submerged assumes considerable importance when it is considered that the *elements most liable to disability in the submarine boat of to-day are the storage battery and its electrical equipment.*"

The following quotation from the board's report gives the experience of its members:

The board was on board from 10:15 A. M. to 4 P. M. of January 19, 1904. From about 12 M. to 3 P. M. the boat was submerged, and from 12:40 to 2 P. M. the board was in the diving compartment, observing its operation and that of grappling for a cable.

No discomfort was experienced under the air pressure in the diving chamber, and the remaining part of the interior was quite as comfortable as any surface boat of its size would have been. Lunch was cooked and served while submerged.

PROGRAMME.

1. Proceeded from Fort Adams (Newport, R. I.) some three miles up Narragansett Bay in cruising condition, using engines.
2. Passed from cruising to awash condition, housing all external fittings, except a wooden mast installed for the naval test.
3. Continued surface run in awash condition.
4. Passed to submerged condition by filling ballast tanks.
5. Maneuvered on the bottom of the bay, by using storage batteries and motors to propel the boat.
6. Filled diving chamber with compressed air, opened door in bottom, and, with a grapnel, picked up a telephone cable by moving slowly over its approximate position.
7. Passed from submerged to awash, and thence to cruising condition, and returned to Fort Adams by a surface run, using storage batteries and motors.

In passing from the submerged to the awash condition, it was found that an ice floe had drifted over the boat, which, on rising, broke through the floe and emerged with its deck completely covered with some eight inches or more of ice, which remained on deck while passing to the cruising condition. It was also found that the wooden mast above mentioned had been broken by the ice while the boat was maneuvering under it.

The weather was very cold (zero), the bay full of ice, and it would have been difficult to have chosen more adverse conditions for the test.

CONCLUSIONS AND RECOMMENDATIONS.

For Defense.

The board believes that this type of submarine boat is a most valuable auxiliary to the fixed mine defense, and, in cases where channels cannot be mined owing

to depth, rough water, swift tides, or width of channel, it will give the nearest approach to absolute protection now known to the board. The boat can lie for an indefinite time adjacent to the point to be defended, in either cruising, awash, or submerged condition by its anchors being upon the bottom. It is thus ready for instant use, practically independent of the state of the water, and in telephonic connection with the shore. It can also patrol a mined or unmined channel, invisible to the enemy, and able to discharge its torpedoes at all times. It possesses the power of utilizing its engines in every condition except the totally submerged, and can always charge its storage batteries while so doing, necessitating its return to shore only when gasoline must be replenished. In narrow channels the boat or boats would have a fixed position, with a telephone cable buoyed or anchored at the bottom. In wide channels they would patrol or lie in mid-channel, or where they could readily meet approaching vessels.

As a picket or scout boat, outside the mine field or even at extreme range of gun fire, telephone communication can be sustained, and information received and instructions sent for attacking approaching vessels.

The test at Newport demonstrated the ease with which the boat can locate and pick up cables and, with minor alterations in the present model, junction-boxes, etc., can be taken into the diving compartment and repaired at leisure while absolutely protected from hostile interference. The faculty possessed by the boat of maneuvering on the bottom and sending out divers, leaves little or nothing to be desired in its facilities for doing this work.

For Attack.

The boat shows great superiority over any existing means of attacking mine fields known to the board.

It can run by any mine field, as at present installed, with but little or no danger from the explosion of any particular mine or from gun-fire, durin the few seconds it exposes the sighting-hood for observation, and can attack at its pleasure vessels in the harbor.

The board personally witnessed the ease with which cables can be grappled, raised, and cut, while the boat is maneuvering on the bottom. Mine cables can be swept for, found, and cut, or a diver can be sent out for that purpose.

It should be noted that, with one exception, no seamen are needed aboard, this exception being the man who steers and handles the boat.

The crew is as follows: One navigator, who is also the diver; one chief engineer, one assistant engineer, one electrician, one machinist, one deck h[illegible], one cook.

The board recommends consideratio[illegible] the foregoing by the General Staff. The question of the use of the Whitehead torpedo as part of [illegible] fixed m[illegible] defense, fired from tubes on shore, is [illegible] consideration. Where channels are wide and water[illegible] swift, this use of the Whitehead will be very limited. With boats of this type the Whitehead can, it is believed, be carried within certain effective range in all ordinary channels, and this, alone, will warrant the consideration asked.

The board recommends, in consequence of its conclusions, that five of these boats be purchased for use in submarine defense, as follows:

One for the School of Submarine Defense, for experimental work.

One for the eastern entrance of Long Island Sound.

One for the entrance to Chesapeake Bay.

One for San Francisco Harbor.

One for Puget Sound.

The necessity for this kind of defense in the four localities named, needs no demonstration, to those acquainted with them.

Narragansett Bay will be entirely free of ice in about four weeks, and then the naval board will try out the "Protector."

RESULTS OF RECENT EXPERIMENTS WITH N-RAYS.

M. Blondlot has now succeeded in measuring the wave length of the new N-rays, and finds that the wave lengths are shorter than for light rays. In the first place, he shows that the rays are equally refracted by a prism. To study the dispersion and the wave lengths of the N-rays, M. Blondlot uses a method similar to that employed in the case of light. Prisms and lenses of aluminium are used, as this metal does not store up the rays like some other bodies. For the dispersion experiments, the rays are produced by a Nernst lamp inclosed in a sheet-iron box having an opening closed by an aluminium shutter. The rays are then passed through an inch thickness of pine, a second aluminium sheet, and two thicknesses of black paper, so as to eliminate all other radiation. In front of the screens and at 6 inches from the burner is placed a large screen of wet cardboard, which cuts off all the rays except a beam passing through a slit 1-5 inch wide and 1.4 inch long, cut out of the cardboard. The beam falls on an aluminium prism whose refracting angle is 27 deg., 18 min. One face of the prism is perpendicular to the beam. With this arrangement, it is found that several beams of N-rays are dispersed horizontally from the other face of the prism. To locate them, a narrow band of sulphide of calcium is moved about the region. Its increase in brightness shows the presence of the rays. Different beams were found and their index of refraction measured. These indices are 1.04, 1.09, 1.29, 1.36, 1.40, 1.48, 1.68, 1.85. To check up the results, the images of the burner were formed by means of an aluminium lens, measuring their distance from the lens. The latter (plano-convex) had a 2.6-inch radius of curvature. A 2-inch hole was made in the cardboard screen. The lens was placed at a known distance from the incandescent burner, and the image of the burner was explored by the phosphorescent screen. This method gave similar results for the indices of refraction of the different beams.

The next step was to measure the wave lengths of the various beams, and it was found, contrary to expectations, that these are much shorter than light waves. With the above disposition, the beams obtained were quite distinct from each other. The beam to be observed is let fall on a second screen of wet cardboard having a narrow slit of 0.06 inch. To explore this narrow beam, an arm moving around a circular transit scale holds a vertical sheet of aluminium having a slit 1-400 inch wide, filled with the phosphorescent sulphide. Placed in the path of the beam, the exploring screen shows that the beam is narrow and uniform, and not accompanied by diffraction fringes. After this preparation, the beam is let fall upon a diffraction grating on glass (one of the Brunner pattern was used, ruled to 1-200 millimeter). The rays coming through the grating are explored by turning the phosphorescent screen through different angles, and it is found that a system of diffraction fringes exists, as in the case of light. However, the bands are closer together and are practically equidistant. This shows that the N-rays have much shorter wave-lengths than those of light. By rotating the exploring screen, the distance between the bands is measured. The angle of rotation is very small, and it is measured by a mirror and telescope, preferably between every tenth ray. From these distances and the ruling of the grating, the wave length is deduced by the usual formulæ. Different gratings gave practically the same wave-lengths, which are as follows for five of the beams:

Index of refraction.	Values of μ
1.04	0.00815
1.19	0.0099
1.4	0.0117
1.68	0.0146
1.85	0.0176

The Newton's ring method was also used and gave similar results. These measurements show that the wave lengths of the N-rays are considerably shorter than those of light rays. It is a noteworthy fact that the wave length of the N-rays increases with the index of refraction, which is the contrary to the case of light rays.

In a paper recently presented to the Académie des Sciences, M. De Lepinay shows that the N-rays are produced by sonorous bodies in vibration. The fact that compression or bending of a body causes it to emit N-rays (as M. Blondlot found) led the author to suppose that sound vibrations should produce the same effect, seeing that a sounding body undergoes alternating strains which, although very slight, are, on the other hand, repeated many times per second. This was found to be true, using a phosphorescent screen to detect the rays. The bodies used were a tuning-fork, a bronze bell, and, especially, a large steel cylinder suspended by two cords and vibrating transversely from the blow of a hammer. The latter gave the best results. The phosphorescence increases on producing the vibrations, and diminishes progressively when the vibrations are suddenly stopped. It is found that the sonorous body is not the exclusive source of the N-rays, but also the air which surrounds it and transmits the vibrations. The air, in fact, undergoes alternate strains and forms a source of the rays. It is found that the action of the vibrating cylinder upon the phosphorescent screen still keeps up if a lead plate 0.1 inch thick or a screen of distilled water 1 inch thick is disposed so as to absorb all the N-rays coming from the vibrating body, without hindering the propagation of the vibrations to a point near the phosphorescent body. Still more striking are the experiments made with a siren as the source of sound, as in this case there are no metal parts engaged in the vibration, this being produced by the air alone. The action on the phosphorescent sulphide is clearly observed when it is placed a little above the revolving disk. Seeing that the N-rays have the property of increasing the brightness of a body which is feebly illuminated, an interesting experiment is the following: The revolving disk of the siren itself is used as the illuminated screen, and it receives a dim light from a window at a distance, so regulated that none of the details of the disk can be distinguished by the eye. The disk having been set in rotation beforehand, the experiment consists in passing the air through the siren and suppressing it again. Each time the air passes and the vibrations are produced, the disk appears with a stronger light, and at the same time the details are perceived, together with other parts of the siren. On stopping off the air, the whole goes back to obscurity. The effect is the same when the observer stops his ears, and it is not due to reflex action, as has been proved in different ways.

EXAMINATION OF THE EMANATIONS GIVEN OFF BY RADIUM.

The fact that a part at least of the emanation from radium is transformed into helium is brought out in a striking manner by the recent researches of M. Curie and Prof. Dewar, which were presented to the Académie des Sciences.

A sample of 0.4 gramme of bromide of radium, pure and dry, had been left for three months in a glass bulb which communicated with a small Geissler tube and a mercury manometer. At the start of the experiment, a high vacuum had been made in the whole apparatus. During the three months, the radium salt gave off gas continuously at the rate of 1 cubic centimeter per month at atmospheric pressure. Spectroscopic examination of the gas by means of the Geissler tube showed only the presence of hydrogen and mercury vapor. No doubt a small quantity of water had been introduced into the apparatus at the same time as the radium salt, and it became decomposed gradually by the radium. The same sample of bromide of radium was taken to England and used in Prof. Dewar's laboratory at the Royal Institution for measuring the heat given off at low temperatures. In this case the salt had been transported in a quartz bulb provided with a tube of the same substance. A vacuum was made in the bulb and the quartz tube containing the salt was heated to redness, up to the fusing point of the salt. The gases given off by the bromide were collected by a mercury pump, and after passing through a set of U-tubes cooled by liquid air which condensed the greater part, the remainder of the gas was collected in a test-tube over mercury and examined by Prof. Dewar. The gases occupied a volume of 2.6 cubic centimeters at atmospheric pressure. They had brought over a part of the radium emanation and were radio-active and luminous. The light given off by the gases in the test-tube, after three days' exposure with a photographic spectroscope of quartz, gave a discontinuous spectrum. It consisted of three lines coinciding with the three principal bands of nitrogen, 3,860, 3,590, and 3,370. During the three days, the glass tube had taken a deep violet hue, and half the volume of gas had been absorbed.

When a spark was passed through the gas placed in a Geissler tube, the nitrogen bands also appeared in the spectroscope. Upon condensing the nitrogen in liquid hydrogen, a high vacuum was produced in the Geissler tube, and the spark showed the presence of nitrogen alone. The quartz tube containing the bromide of radium, melted and now deprived of all the occluded gas, had been sealed by the oxy-hydrogen blowpipe while a vacuum was made, and brought back to Paris. M. Deslandres examined it with the spectroscope about twenty days after the sealing of the tube. The gas inside the tube, illuminated by an induction coil using two rings of tin foil around the tube as the poles, was found to give the *entire spectrum of helium*. There were no other rays except those of helium after an exposure of three hours with a quartz spectroscope.

A YEAR'S BATTLESHIPS IN ENGLAND.

During the past year fourteen vessels, excluding torpedo craft, were added to the British navy, representing a tonnage of 149,340 and an indicated horse power of 262,800. The list includes five battleships, all of the "Duncan" class. These vessels are of 14,000 tons, and are the fastest in the British navy, their speed being 19 knots. Seven new armored cruisers have been commissioned, with the result that the cruiser squadron has been strengthened, and is now not only the most powerful but the fastest fleet in the world, all of the ships having a full-power speed of 23 knots. The ships commissioned this year include the "Drake" and the "Leviathan," of 14,100 tons, with engines of 30,000 indicated horse power. The five other cruisers commissioned are the "Kent," "Bedford," "Monmouth," "Donegal," and "Berwick," all, with the first exception, built on the Clyde. These vessels are of 9,800 tons and 22,000 indicated horse power. The remaining two ships commissioned during the year were the sloops "Merlin" and "Odin." The armament of the ships may be regarded as indicating the power of attack, and thus it is interesting to note that this year's newly commissioned ships had in all twenty 12-inch guns, four 9.2-inch weapons, 106 6-inch quick-firers, and 239 smaller weapons.

THE TYGARD RECIPROCATING-CYLINDER DOUBLE-ACTION GASOLINE MOTOR.

Our illustrations show very well the general appearance and constructional details of a novel gasoline motor that was exhibited by James W. Tygard, of Plainfield, N. J., at the recent Automobile Show. The inventor made use of a 3-horsepower de Dion motor as a basis for his new engine. He removed the cylinder of the former, and bolted to its crank case instead the square casing of aluminium that contains the reciprocating cylinder and its stationary piston. The upper portion of the new motor, which replaces the de Dion cylinder, consists of three parts—an outer casing bolted to the crank case, and containing at its lower end a slide for a cross-head; a stationary piston fitted with two rings at each end, and supported in trunnions in the center of the casing; and a long cylinder slotted on its sides in the center part, so as to be movable on the piston without interference from the trunnions of the latter. This cylinder is made up of two pieces of steel tubing of ⅛-inch wall, lapped together at the center of the piston, and held tightly to each other and their respective cylinder heads by six rods that pass alongside of them and through the heads. A cross-head is attached to the lower end of the cylinder, and this, together with the piston, acts as a guide for it. The connecting rod of the motor is fitted to a wrist pin in the cross-head.

The motor piston, instead of being flat at each end, is cupped out and fitted with exhaust, inlet, and spark ports opening from the round center chamber or valve seat, into each cylinder space. These ports are 90 deg. apart, and a glance at the end view of the piston in Fig. 4 will show them to the reader as white slits on each side of the center. By their use the gas enters and leaves the cylinder directly through the head, or through what corresponds to the head in an ordinary motor. The spark also occurs in this place, with the result that the quickest possible inflammation of the gas is obtained, while the full force of the explosion is obtained directly against the piston, with the least possible loss of heat. Within the center chamber of the piston is a rotary valve, that makes one revolution to every two of the motor crank shaft. This valve is a hollow shell, with ports and two central transverse partitions, that divide it into three chambers. One of these serves as an inlet and the other as an exhaust outlet, while into the middle one there extends a tube with two notches on its end, which, in conjunction with a stationary steel wire that rubs over the projections and falls into the notches, forms a reliable igniter of the simplest possible construction. The valve is slightly tapered, and is well lubricated by oil fed to it through tubes that lead to holes seen in the trunnions on each side of the piston (Fig. 4). Other oil pipes distribute oil on the sides of the piston, as shown in Fig. 2, while the cross-head is oiled by splash lubrication from the crank case. The rotary valve is turned by a Renold silent chain. It is readily removable, as is also the igniter. The latter can be taken out by unscrewing the two nuts on the upper end of the valve stem, Fig. 3. The central steel wire, which has its inner end bent somewhat like a fishhook, is connected through the coiled spring on it to the wire from the battery. This spring also passes through an insulated cross-piece connecting two studs, which are screwed into a movable collar on the right-hand end of the piston trunnion, as shown in Figs. 2 and 4. The coil spring is stretched sufficiently to keep the inner hooked end of the central igniter wire in contact with the notched end of its tube. The wire is insulated from the tube by fiber bushings. A small metal piece seen on the wire just above the two nuts has a pin projecting from it. This pin contacts with a projection on one of the two studs, which keeps the igniter wire from turning. As the notched tube containing the igniter wire turns with the valve, the wire, being held stationary, has the notches revolved against its hooked end, with the result that every time one or the other of the two notches wipes past it, a large primary-current spark ignites the charge in the proper cylinder space. The collar into which the studs are screwed is threaded on the trunnion, and by rocking it by means of the small handle, the time of the spark can be varied. The cast-iron heads of the cylinder are U-shaped in cross section, and fit closely into the hollowed-out piston when compressing a charge. Compactness is gained by this arrangement, besides very little of the cylinder wall being exposed to the hot, burning gases. The cylinder wall is perforated in the center portion, which is never off the piston, in order to aid in cooling the latter. This is accomplished by the pumping action of the rapidly-moving cylinder drawing in air and expelling it at every stroke, as well as by the suction of the air for the carbureter, which is taken from around the piston through the pipe coming out from the trunnion on the sprocket side of the casing. The pipe on the other or front side (Fig. 1) is that for the exhaust. The inlet pipe is connected to the center of the rotary valve on the sprocket end. The valve is of cast iron turning in a steel casing, and having 1-16-inch end play. The single, stationary, double-ended piston is well shown in Fig. 3, where the two packing rings are visible at the end of the piston, disclosed to view by the removal of the upper half of the cylinder. The bore of the cylinder is 2¾ inches, and its stroke is 3 5-32. The power of the motor has been about doubled, with the addition of one-fifth its weight. The total weight at present is 120 pounds.

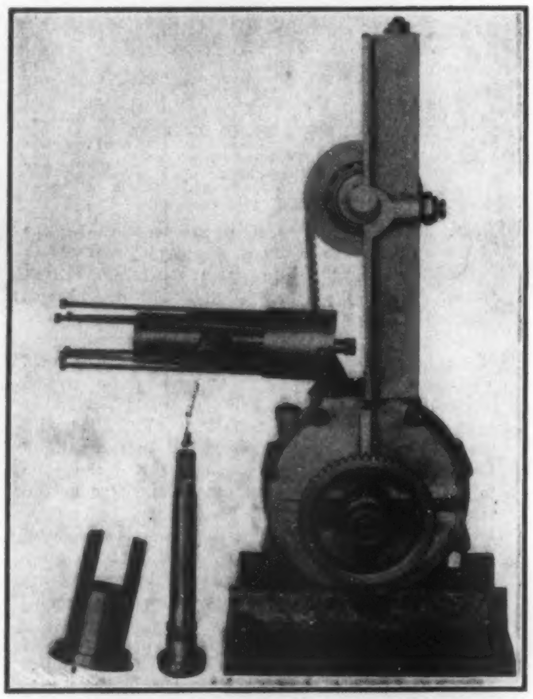


Fig. 3.—Motor With Half of Cylinder and Rotary Valve Removed.

The motor operates on the regular four-cycle principle, two impulses one-half revolution apart being obtained every other revolution. The air cooling is effective on this sized motor; while another valuable feature is that by opening a cock in the upper cylinder head, which can be done while the motor is running, it can be run on the lower cylinder only, thus developing but half its power, and running at half its regular fuel consumption with full compression in one cylinder. The rotary valve forms a positively-actuated valve of the simplest possible construction, the wear of which will be little or nothing, as it practically runs in oil. This type of valve advantageously replaces a suction-operated inlet valve and a mechanically-operated exhaust valve, since it does away with the throttling effect of the former, and saves the power lost in raising the latter against the exhaust pressure. Its rotary action is noiseless at all speeds. A company is being incorporated to manufacture this motor at Plainfield, N. J.

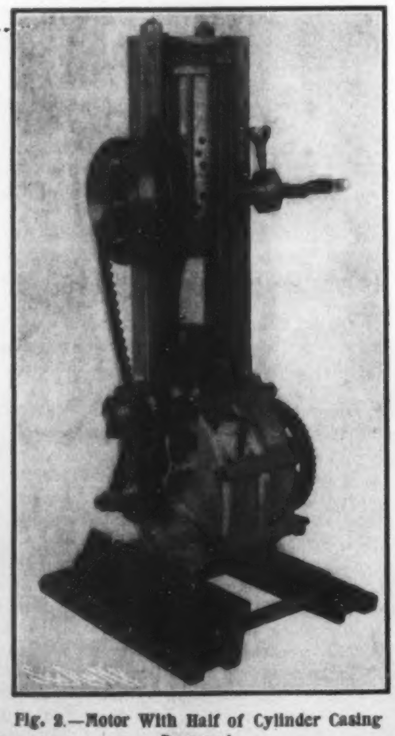


Fig. 2.—Motor With Half of Cylinder Casing Removed.

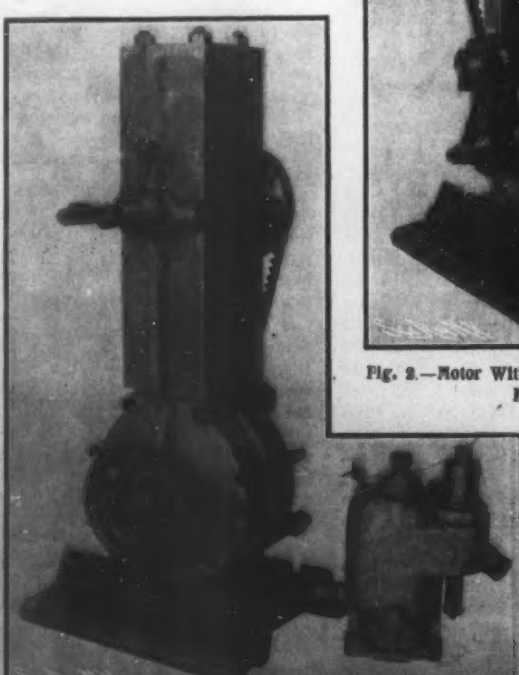


Fig. 1.—Tygard Motor Complete, With de Dion Cylinder Beside It.

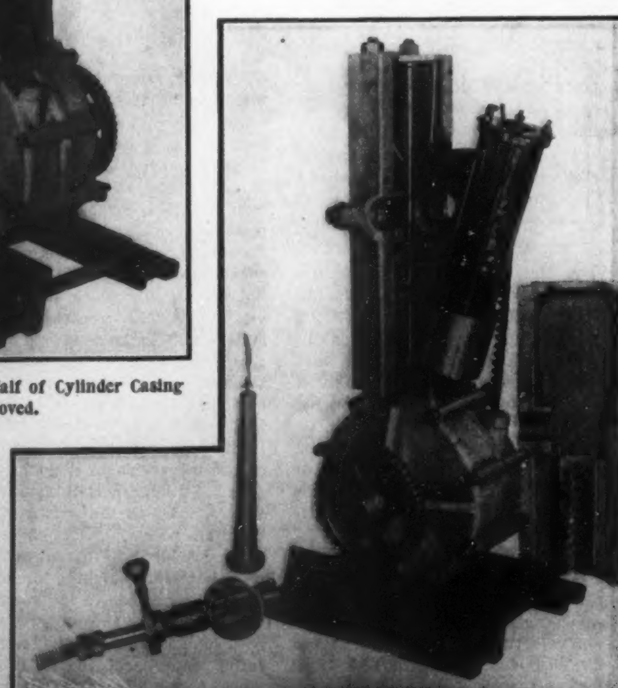


Fig. 4.—Motor With Piston Removed.

In the end view of piston, which is seen in foreground, two slots indicate the valve ports.

THE TYGARD RECIPROCATING-CYLINDER DOUBLE-ACTION GASOLINE MOTOR.

Automobilists if they desire to be rendered free from tire troubles should see that their tires are properly and fully inflated, as many of the troubles experienced in this direction are to a great extent attributable to insufficient inflation. The object of a pneumatic tire is to support the weight of the vehicle acting on the rims of the wheels upon a cushion of compressed air. If, therefore, a tire is not fully inflated, the weight instead of being supported upon the compressed air, is borne by the rim, and the tire is consequently jammed between the ground and the rims of the wheel, with the result that it is rapidly destroyed. The edges of the outer cover of the tire are cut away, or there is an undue wear upon the external rubber layer at the points where the latter comes into contact with the edge of the rim and the inner tube. The latter is consequently being nipped continuously, with the result that it is soon punctured with a number of minute holes and is quickly decomposed. A fully inflated tire, on the other hand, affords a thick cushion of compressed air between the rim of the wheel and the ground, and although the outer covering may be worn away through friction with the road, the inner tube is preserved, while greater comfort and ease in riding are obtained.

THE DEVELOPMENT OF THE HIGH-SPEED LAUNCH OR AUTOMOBILE BOAT.

Our illustrations show two new motor-boat hulls designed recently by Mr. Sutphen Sutphen, and built by the Electric Launch Company, of Bayonne, N. J., one for the American branch of the Paris firm of Panhard & Levassor, and the other for Hollander & Tangeman, the American representatives of the Italian F. I. A. T. motors and automobiles; while the line cut gives a longitudinal section, plan view, and transverse sections of a speed launch designed, built, and run successfully last summer by Mr. C. D. Mower, the official measurer of the New York Yacht Club and the editor of "The Rudder."

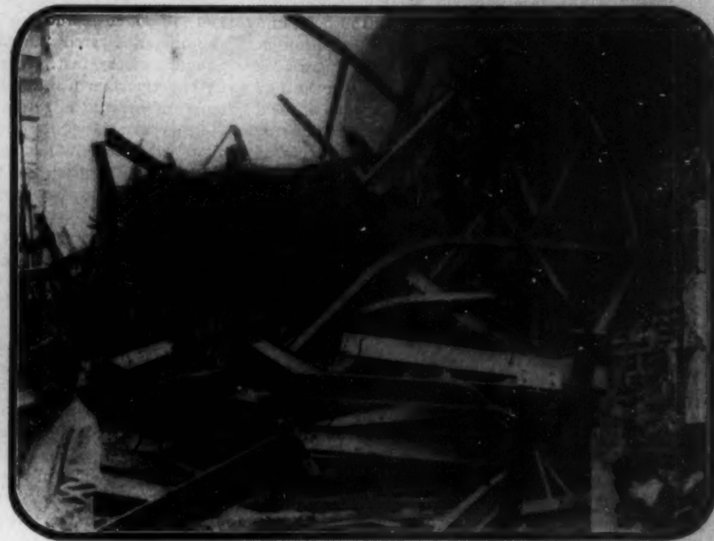
When, last summer, French automobile enthusiasts organized an automobile boat race from Paris to the sea, and carried out the same successfully on the quiet waters of the Seine, Americans recognized, from the pictures and published reports of the participants, that the French automobile boat was but a lighter and speedier type of the standard American launch, such as has been in use here for more than a decade past. In fact, some of the automobile boats were simply American launches, such as the Lozier and the Eagle, which participated in the cruiser class. The English Napier 40-foot automobile boat, fitted with a 75-horse-power motor, won from a French boat, fitted with a German Mercedes motor, in a race held at Trouville after the termination of the former races. The Napier boat had previously covered 8½ miles in 24 minutes, 44 seconds, in the race for the Harmsworth trophy in Queenstown harbor, as illustrated in our issue of August 8, 1903; and it beat the Mercedes 10 1-5 seconds in a mile race, its time being 3:30 3-5, which is equivalent to a speed of 17 1-3 miles an hour. It also won from this boat in a 3-mile race.

The success of the motor boat abroad led importers of foreign automobiles and motors to build such speed craft in this country, and the hulls illustrated herewith are two of the latest to be built in America.

The F. I. A. T. hull, which is shown lifted by three men, weighs but 550 pounds, and its weight complete, with motor and accessories fitted, is 1,300 pounds. The hull is 35 feet long by 4½ feet beam; and it is built of two layers of narrow, thin planking, the outer layer, of mahogany, running horizontally, and the inner one, of cedar, diagonally. The two layers have a sheet of specially prepared, very thin canvas between them, and they are riveted together by 20,000 small copper rivets. A 24-horse-power F. I. A. T. motor of 130 millimeters (5.118 inches) bore and stroke and capable of a maximum speed of 1,100 R.P.M. drives the propeller shaft through a regular automobile cone clutch. The propeller is a three-bladed one, of 36 pitch.

A general idea of the lines of the peculiarly shaped hulls of these two boats is to be had from the cross sections of Mr. Mower's boat, the "Express," which are

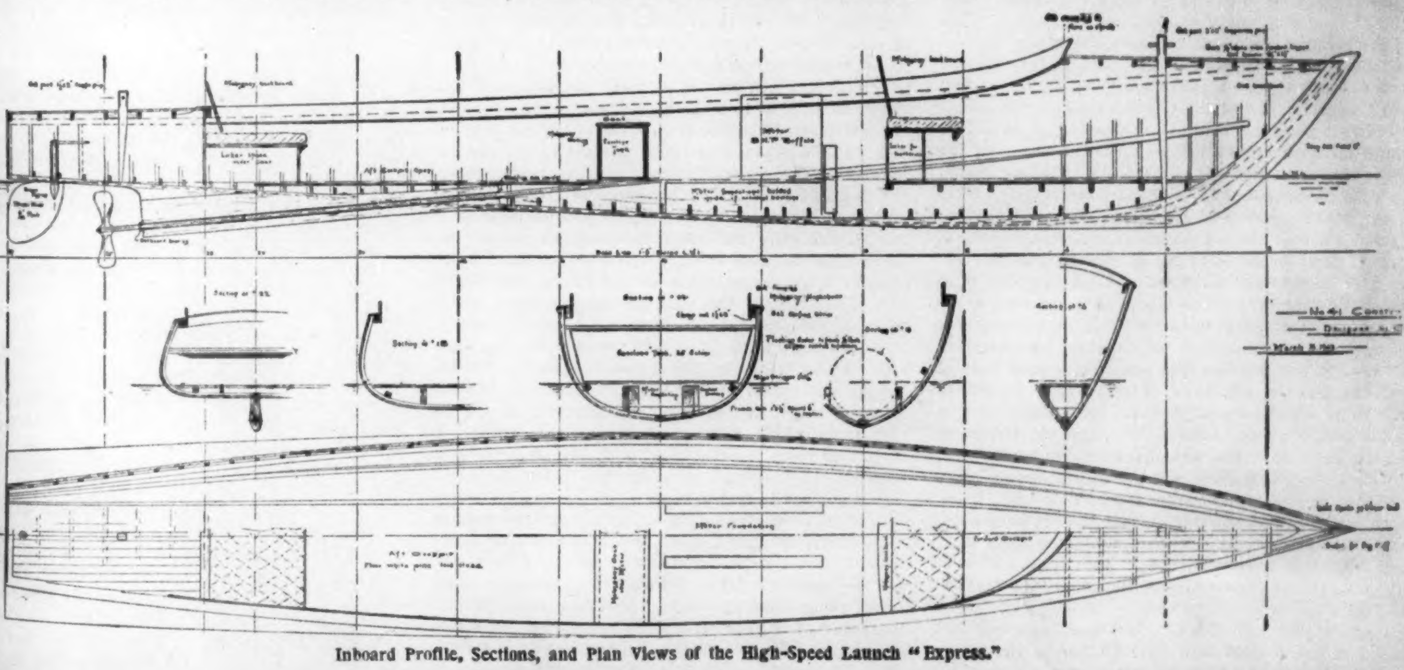
Looking Northwest, Showing the Westerly Wall.



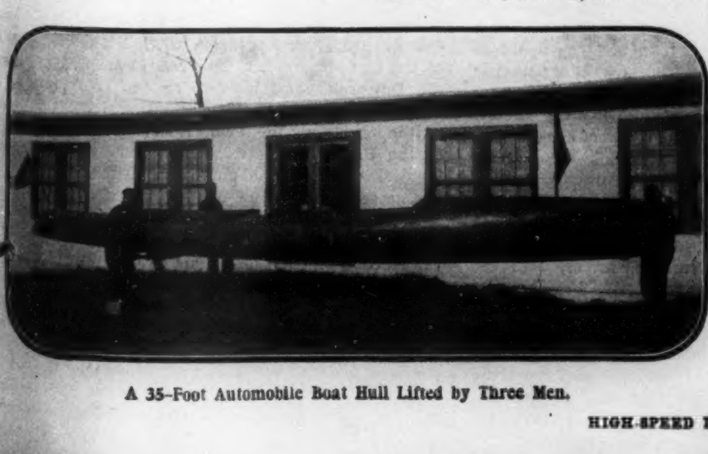
Looking Northeast, Showing Easterly Wall.

Note in foreground of both views the broken flange bolted to base of overturned cast iron column. The mottled effect is due to the honeycombed condition of the flange. In its fall the building hinged against the tall building seen to the rear, scoring the brickwork and sweeping down the fire-escapes. The wreck is discussed in our editorial columns.

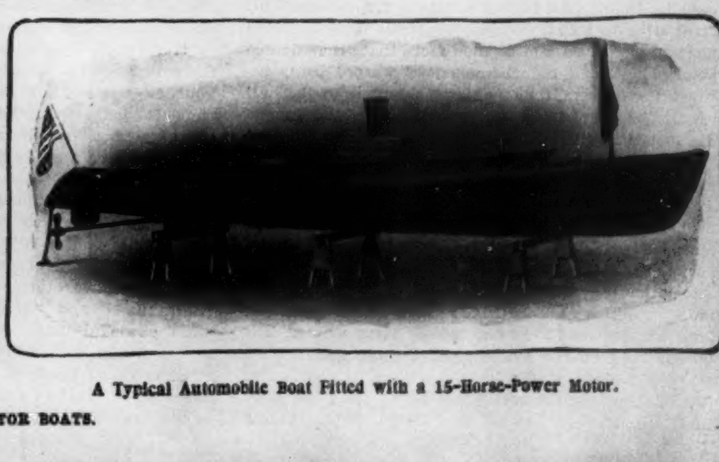
THE DARLINGTON APARTMENT HOUSE DISASTER, NEW YORK CITY.



Inboard Profile, Sections, and Plan Views of the High-Speed Launch "Express."



A 35-Foot Automobile Boat Hull Lifted by Three Men.



A Typical Automobile Boat Fitted with a 15-Horse-Power Motor.

HIGH-SPEED MOTOR BOATS.

shown in the annexed diagram, while the general arrangement of all boats of this kind is also to be noted in the longitudinal section and plan views. As the five cross-sections of the hull of the "Express" clearly show, the bow is of a very sharp V section so as to cleave the water easily, while this sharp V section is modified and made rounding toward the middle of the boat, and changes gradually to an extremely flat U section at the stern, so that the after body, with its decreasing draft, slides on the surface of the water. The hull of the F. I. A. T. boat, besides being flat, tapers upward at the stern sufficiently to clear the water line for the last four feet of its length when the boat is at rest. When the boat is in motion, however, its stern rests on the water, and its total water line is then 34 feet. The hull draws but 8 inches of water, the point of greatest draft being at the bow. This boat is to race the "Vingt-et-un"—the Smith & Mabley 31-foot racing launch equipped with a four-cylinder 3 13-16 x 5¼ American-built Mercedes motor, and a 16-inch three-blade propeller of about 28 pitch—for a valuable cup trophy. The "Vingt-et-un," it is claimed, made a mile on the Hudson River, on November 5 last, and with the wind and tide, in 2 minutes, 26 seconds. She is rated at 18 horse power, but her builders declare she will develop 22. Her weight complete at the time of the trial was 850 pounds. The lines of this boat are more like those of the regular launch than those of the automobile boats here shown.

The Panhard boat consists of a complete French auto boat equipment in an American hull. The hull is built upon a light oak frame, which is double planked with elm and mahogany, the latter being used on the outside. The 15-horse-power, 91 x 130 millimeter (3.582 x 5.118 inch), four-cylinder motor is placed just ahead of the center of the boat, with the operator's seat in front of it. A regular automobile inclined steering wheel is provided. On each side of the operator is a long vertical lever extending upward from the floor of the boat. One of these operates the cone clutch back of the motor, by which the propeller shaft, with its two globular universal joints, may be disconnected, while the other reverses the propeller blades for reversing. Attached to the boat on each side of the steering wheel is a small handle that moves over a notched segment. One of these handles controls the spark and the other the throttle. The motor is fitted with the Krebs automatic carbureter (described in our issue of February 14, 1903), and it is in every respect like the regular automobile motor. A horizontal exhaust chamber is fitted just below the smoke stack, and the exhaust gases pass out of the latter. This is the arrangement used in France, instead of conveying the exhaust through a pipe passing through the hull and into the water. The rear cock-pit has luxuriously upholstered individual seats capable of accommodating six persons. The boat is expected to make 17½ miles an hour at 750 R.P.M. of the motor. As the latter can be speeded up to 1,200 R.P.M., the boat should be good for spurts of 20 miles an hour or over. This speed, which seems to be the average aimed at, was exceeded a year and a half ago by a 55-foot, 120-horsepower launch designed by Mr. H. T. Leighton, of Syracuse, N. Y., and run on Oneida Lake at a speed of 23 miles per hour over a mile course that had been measured on the ice and staked off when the lake was frozen. Mr. Leighton had built several fast launches previously, and had had the benefit of a good deal of experience with this type of boat. The particular launch in question was 55 feet over all and on the water line, 7¾ feet beam on deck, and 6½ feet beam on the water line. She was of the regular launch type, with a torpedo-boat stern, and her engine was an eight-cylinder one of the two-cycle type. This boat, therefore, is the fastest small craft that has yet been built, and her engine is probably the first eight-cylinder gasoline engine to be constructed in the world. Thus it appears that America still holds the palm in the matter of fast launches.

Another launch of this type that has made very fast speed in and around New York harbor, is the "Standard," a 58-foot boat having a regular torpedo-boat hull fitted with an 8 x 10, six-cylinder, slow-speed, Standard marine motor. Despite the fact that the double planked h. l of 3-16-inch mahogany warped badly between the timbers, thus making the bottom of the hull corrugated instead of perfectly smooth, this boat made the fast time of 21 miles an hour. The hull is being rebuilt, and the builders hope to exceed this speed considerably in the near future.

Among the motor boats exhibited at the recent Sportsmen's Show in Madison Square Garden was the "Dolphin II.," which was designed by Mr. Graef after experiments last summer with a smaller, 25-foot model. The latter boat, driven by a single-cylinder, two-cycle motor, running at 830 R. P.M. made over 13 miles an hour without producing any side or stern waves. The hull is built on the wedge principle, tapering from a sharp V section at the bow to a straight, horizontal line at the stern, the bottom not rounding in the least. The "Dolphin II." has an over-all length of 31 feet, 8 inches; a length on the water line of 30 feet; a beam on deck of 4 feet, 2 inches; and a beam on the water line of 3 feet, 10 inches. The weight of the four-cylinder, 25-horse-power, Standard motor and reversing gear in this boat is 510 pounds, and that of the hull, 564 pounds. The total displacement, with crew aboard, is 1,770 pounds. Judging from the speed attained with the under-powered "Dolphin I.," the new "Dolphin" should be very fast. In the limited space of the tank at the Sportsmen's Show, she has already shown a speed of over 16 miles an hour.

Other firms that are building automobile boats, and that exhibited high-speed, four-cylinder, automobile type motors for the same at the Sportsmen's Show, are the Lozier Motor Company and the American Darracq Company. The former company now has under construction a 25, a 36, and a 37-foot boat of this type, fitted with its 4½ x 5½, 24-horse-power motor; and the latter is fitting up a 32-foot hull designed and built by Herreshoff, with a 3¾ x 4-inch, 20-horse-power engine.

The above description of some of the automobile boats, or high-speed launches, that have been built in this country, shows how the desire for rapid pleasure boats by men of wealth, stimulated by the use of modern and speedy automobiles, has caused the designing of a new type of craft which has been made possible by the development of the high-speed, light-weight automobile motor. In fair weather, this new type of boat may yet be used for business as well as for sporting and pleasure purposes, and it will doubtless open a new era of speed on the water, such that the largest and speediest boats afloat may have to look well to their laurels.

THE JAPANESE DESTROYERS.

Never, surely, in the history of strife upon the sea did an engine of destruction justify its name with such terrible emphasis as when the Japanese torpedo-boat destroyers made their ever-memorable attack upon the Russian fleet at Port Arthur, and in a few minutes time put out of action two modern battleships and one of the finest protected cruisers afloat. Practically no particulars of the fight, or rather of that special part of it that fell to the lot of the torpedo-boat destroyers, have reached us, and it may be several weeks, if not months, before we are authoritatively told in what formation and using what particular tactics the destroyers made their bold raid upon the Russian fleet. According to present accounts, they dashed into close quarters and came within such short range that they could not well miss their mark. The puzzling feature, if this be true, is that the boats should have been withdrawn practically unscathed; for it is a pretty generally accepted maxim that the torpedo boat that comes so close as to make perfectly sure of its quarry is equally sure of paying the penalty of its own destruction. If the attack was made at short range, the immunity of the destroyers could only be explained by the probable fact that in ignorance of the imminence of war the officers were ashore, the crew in their hammocks, and only an ordinary peace-time watch was being kept. In such case, it would be possible for the torpedo boats to make the circuit of the battleships and escape before the gun detachments could reach their stations and open fire with any kind of accuracy.

On the other hand, it is quite possible that the Russian fleet, being anchored near the harbor entrance, was rather closely bunched together. The destroyers may have discharged their torpedoes at a long range of say 2,000 yards, and simply directed a stream of them into the fleet, with the certainty that although some might pass through, other torpedoes would be sure to find a mark.

The Japanese fleet of destroyers, like the rest of their navy, is brand new, and embodies the latest ideas of the two leading torpedo-boat builders of the world—Thornycroft and Yarrow. The oldest of their boats, represented by the destroyer "Usugumo," is not more than five years old. The "Usugumo" is one of six similar vessels built by Thornycroft at Chiswick, England, and launched in 1898-1900. The dimensions are as follows: Length 210 feet, beam 19.5 feet, and draft 7.2 feet; displacement, 275 tons. The speed of these six vessels varied from 30 to 30.55 knots per hour on trial. Each is armed with one 12-pounder rapid-fire gun, mounted forward, and five 6-pounders. They carry a complement of fifty-four officers and men, and have a coal capacity of 80 tons. These half-dozen Thornycroft boats are distinguished by having two large elliptical funnels, most of the other Japanese destroyers having four smaller circular funnels. Each boat carries two 18-inch torpedo tubes.

In 1901-1902, Thornycroft launched for the Japanese government two other destroyers, named respectively "Shirakumo" and "Asashio." They are larger and more powerful boats, 216.7 feet in length, 20.7 feet in beam, and with a draft of 8.3 feet and a displacement of about 300 tons. Twin engines of 7,400 horse power drive them at a maximum speed of 31 knots an hour. The armament is the same as that of the six boats above described. The contribution of the Yarrow firm at Poplar, London, to the Japanese navy is seven destroyers of the following dimensions: Length 220 feet, beam 20.6 feet, draft 9.6 feet, and displacement about 360 tons. With 6,000 horse-power these vessels have shown speeds on trial of from 31 to 31.62 knots an hour. They carry the same armament of one 12-pounder, five 6-pounders, and each mounts two torpedo tubes. The latest of these are the "Kasumi" and "Akatsuki," both of which were launched in 1902. They carry 95 tons of coal and a complement of fifty-five officers and men. All of these vessels have four funnels and a single pole mast forward. The Japanese themselves launched in 1901 at Yokosuka four destroyers of the same dimensions and speed as the last-named Yarrow boats, and these are at the present time believed to be all in commission, making a total of nineteen destroyers.

In closing our description we would say a word with regard to the seaworthiness of these ships. Popularly they are supposed to be suitable only for use in quiet seas and practically calm weather. As a matter of fact, in their long journey from England to the Orient, they showed remarkably good sea-going qualities. This is due largely to their increased size over early torpedo boats, and to the generous freeboard that each of them, as can be noticed from our photographs, possesses. Of course, in heavy weather it is necessary for these boats to slow down to a lower speed than would be required in the case of gunboats, scouts, or small cruisers, and it is in recognition of this fact that the navies are beginning to build vessels of the scout type possessed of an extremely high speed, the most celebrated representative of this class being the Russian cruiser "Novik," which, with a displacement of 3,000 tons, has a speed of 26 knots an hour. It is probable that in rough water the "Novik" would be able to overtake, and destroy with her 4.7-inch guns, any destroyer that she might sight in the open.

The Pelé Club.

The Pelé Club, which is an organization comprising the newspaper and magazine correspondents and artists, the army and navy officers and the scientists of the United States who went to Martinique directly after the great eruptions of May, 1902, held its second annual meeting at the New Willard Hotel, Washington, D. C., on Saturday, February 27. The members of the club, now about eighty in number, are scattered all over the world, so that the attendance at the meeting, though small, was considered very good and those present made up in enthusiasm what they lacked in numbers.

Prof. Robert T. Hill, the president of the club, in the course of his remarks in opening the session, spoke of the large amount of information regarding the characteristics of explosive volcanoes which had been assembled through the efforts of the members of the club. One feature of the record is the great number of photographs taken which have permanent value through the many geological and human phases of the phenomena which are thus preserved. About 1,500 such negatives and prints have been assembled at the American Museum of Natural History which are accessible to all the members. President Hill advanced the proposition that the time was ripe for the expansion of the Pelé Club from the nucleus already in existence so as to include all persons interested in the scientific study of volcanoes and vulcanology. There is no society in this country having for its primary object the study of volcanoes, in spite of a wide interest in the subject. The idea was received with favor and the organization of the new society will be pushed vigorously.

The club has in course of preparation and expects to issue this year a book upon the eruptions, which will be the composite work of many contributors relating largely personal experiences. Dr. E. O. Hovey, the chairman of the editorial committee, reported that chapters had already been submitted by Major H. J. Gallagher, U. S. A., of the general staff, on the organization of the United States relief expedition and the assembling of the stores; by Lieut. Commander J. B. Barnadou, U. S. N., on the nature of the exploding cloud; by Prof. Israel C. Russell, of the University of Michigan, on the contributions to the science of vulcanology resulting from the study of the eruptions; by Prof. Robert T. Hill, formerly of the United States Geological Survey, on the geological history of the Caribbean islands; by August F. Jaccaci, formerly of McClure's Magazine, on Père Mary, the brave parish priest of Morne Rouge, the real hero of the time; by H. H. Smith, relating how the correspondents did their work; and by other members of the club, relating personal experiences or contributing scientific observations.

During the evening Dr. Hovey related the history of the wonderful spine which rose above the top of the new cone of eruption and dominated the mountain from October, 1902, to July, 1903, full description of which appeared in the Scientific American

and SUPPLEMENT for December 5, 1903. He also brought the description down to date.

After the destruction of the slender spine in the latter part of July and the early part of August, 1903, the "dome" of the new cone rose bodily until it had regained a large part of the height lost by the spine. Then after the great activity of September, 1903, had lessened, the dome was seen to be altering its contour from day to day, the southwestern side of the top being blown away by the numerous small eruptions, leaving a pronounced narrow ridge along the northeast side of the top of the new cone. In December this showed an almost overhanging face toward the southwest, while a new spine or obelisk was becoming prominent on the site of the earlier one. In January, 1904, the reports state that the new cone presented a double summit, the one very sharply conical and the other jaggedly turreted. There is but little activity now, though steam rises copiously from time to time, and an occasional "dust-flow" descends upon the upper portion of the Rivière Blanche gorge.

The slopes of the mountain which were protected from the fury of the volcanic hurricanes are now thickly covered with grass, and the greater part of the town is green, too. Comparatively few walls are standing, and the site of St. Pierre looks like a plowed field.

The officers of the club are: President, Prof. R. T. Hill, geologist, and secretary, Mr. H. H. Smith, of the Washington bureau of the World. The next meeting will be held in New York in the fall.

The Commercial Far East.

"Commercial Japan in 1904," "Commercial Russia in 1904," "Commercial Korea in 1904," and "Commercial China in 1904" are the titles of monographs just prepared by the Department of Commerce and Labor through its Bureau of Statistics. These monographs, which discuss commercial and other conditions in the countries in question, are now in the hands of the printers and will be published as a part of the Monthly Summary of Commerce and Finance, a portion in the issue to be made within a few days, and the remainder in the issue at the close of the present month. They discuss commerce and commercial conditions in each of the countries in question, not only at the present time, but the history of their commerce, their trade relations with the various parts of the world and with each other, the total value of their present commerce compared with that of earlier years, their trade with the United States, with other leading countries of the world, and with each other. Many other important facts regarding conditions in those countries are also discussed, such as railways, telegraphs, routes of communication, manufacturing industries, the class of merchandise imported, and the class of merchandise exported.

The total commerce of the territory fronting upon and immediately adjacent to the scene of present hostilities aggregates, in round terms, about $600,000,000, of which considerably more than one-half is imports. Japan's commerce is about equally divided between imports and exports, but in the case of China and Asiatic Russia imports greatly exceed exports, and this is also true of Hongkong, which passes most of its imports on into China and draws from China most of the articles which become its exports. Probably three-fifths of the total commerce of the countries in question, taken as a whole, is in the form of imports, and the United States is year by year supplying a larger share of those imports of the countries in question and gaining upon other countries in the relative share which it supplies thereof. Of the exports from the countries named, the United States is the largest single purchaser. The tea, the raw silk, the manufactured silk, the rice, the mattings, and other products of this character which form the bulk of the exports of China and Japan go more largely to the United States than to any other single country of the world, while as to Asiatic Russia and Korea, their exports are at present so small as to be of little importance in a discussion of the commerce of the countries in question.

The more important of the exports of the United States to the section in question are cotton and cotton goods, kerosene, flour, lumber, manufactures of iron and steel, manufactures of leather and tobacco. Raw cotton exported to this particular section of the world goes chiefly to Japan, and the market in Japan for American cotton is influenced largely by the surplus of cotton in India, which is of shorter staple and therefore of lower price. In years of short supply in India Japan turns to the United States for its raw cotton, but in years of plentiful supply in India a large proportion of the raw-cotton purchases of Japan are the product of India. In cotton manufactures China is the most important customer. The exports of cotton manufactures to China in the past year have materially fallen off, though the reduction in imports of American cottons into China is no greater proportionately than the reduction in such imports from other countries. This reduction in importations of cotton goods into China is due in part to the unsettled conditions which have prevailed during the year, and in part to the increased importations of cotton yarn and increased domestic production of cotton goods.

Kerosene is an even more important item in our exports to the Orient, and in this article the trade is barely holding its own, kerosene from Russia and Sumatra proving a very active competitor. To China the exports of mineral oils from the United States fluctuate greatly, ranging all the way from 20 to 55 million gallons per annum. In 1901, for example, the total was 27 million gallons; in 1902, 57 millions, and in 1903, about 20 millions. To Hong-Kong the shipments are more steady, ranging from 15 to 18 million gallons per annum. To Japan the shipments also fluctuate in some degree, though not so greatly as in the case of China. In 1899 the total to Japan was 32 million gallons; in 1902, 59 millions, and in 1903, 35 millions.

Flour as a factor in our export trade to the Orient has of late attracted coniderable attention, but the total is not large, nor the growth rapid. The total value of flour exports to the Orient from the United States in the last fiscal year was: To Hong-Kong, $4,628,224; to Japan, $2,247,199; to China, $289,637, making the total to the countries under consideration $7,165,060, or less than 10 per cent of the total exports of American flour in 1903.

The Mystery of Worlds.

"Few people need to be told that a rotating fluid mass is shaped very much like an orange," says Miss Agnes M. Clerke, writing in Knowledge on "The Fission of Rotating Globes." "It assumes the form of a compressed sphere. And the reason for its compression is obvious. It is that the power of gravity, being partially neutralized by the centrifugal tendency due to axial speed, gains progressively from the poles, where that speed has a zero value, to the equator, where it attains a maximum. Here, then, the materials of the rotating body are virtually lighter than elsewhere, and consequently retreat furthest from the center. The 'figure of equilibrium' thus constituted is a spheroid, a body with two unequal axes. In other words, its meridional contour—that passing through the poles—is an ellipse; while its equator is circular. Now we know familiarly, not only that a spinning sphere becomes a spheroid, but that the spheroid grows more oblate the faster it spins. The flattened disk of Jupiter, for instance, compared with the round face of Mars, at once suggests a disparity in the rate of gyration. But there must be a limit to the advance of bulging, or the spheroid, accelerated *ad infinitum*, would at last cease to exist in three dimensions! Clearly this unthinkable outcome must be anticipated; at some given point the process of deformation must be interrupted. A breach of continuity intervenes; the train is shunted on to a branch line. Nor is it difficult to divine, in a general way, how this comes to pass. Equilibrium, beyond doubt, breaks down when rotation attains a certain critical velocity, varying according to circumstances, and the spheroid either alters fundamentally in shape, or goes to pieces. So much plain common sense teaches; yet the precise determination of the course of events is one of the most arduous tasks ever grappled with by mathematicians. M. Poincaré essayed it in 1885; it was independently undertaken a little later by Prof. Darwin; and the subject has now been prosecuted for eighteen years, chiefly by these two eminent men, with a highly interesting alternation of achievement, one picking up the thread dropped by the other, and each in turn penetrating somewhat further into the labyrinth."

The Current Supplement.

Mr. Waldon Fawcett opens the current SUPPLEMENT, No. 1471, with a well-illustrated, instructive article on the manufacture of emery wheels. Mr. Charles Stevenson's excellent paper on whale oil is concluded. The Baltimore fire was made the subject of a careful study by Mr. F. W. Fitzpatrick. His conclusions are published in the current number of the SUPPLEMENT. "A Capture of Elephants at the Kraal of Ayouthia, Siam," is the title of a descriptive article that will surely be of interest to many readers. The building of Harbin is described in a paper on the conditions in Manchuria by United States Consul Miller, of Niuchwang, China. The behavior of selenium with regard to light and temperature, a subject which has been of considerable importance to physicists ever since the invention of Prof. Bell's radiophone, is recounted in a brief but valuable discussion.

A yield of 5 cubic feet of acetylene gas from every pound of calcium carbide is guaranteed by manufacturers in the United States. In Germany acetylene gas is mixed with a gas of lower candle power, containing about 25 per cent acetylene, and used in railway cars.

Correspondence.

The Origin of the Sheepeater's Monument.

To the Editor of the SCIENTIFIC AMERICAN:

I have noted with interest your illustration, in your issue of February 13, of "Sheepeater's Monument" in Idaho, with its accompanying article; but the writer of the article does not seem to have made it very clear precisely how the column was formed, which he ascribes to the action of "wind and weather." In fact, he explains its origin in the following language: "At first a cloudburst, possibly, formed a channel; this became a cañon, and as the sides of the mountain washed away, a column-shaped mass, which was more resistant and harder than the rest, was left. *Accident* made the top of the column larger, as *chance* shaped the lower portion."

The author of the paper thus apparently regards the stone capping of the column as a mere incident having nothing to do with the formation of the column. May I be permitted to say, this is an explanation which does not explain. Besides, it is not easy to see how "a column-shaped mass harder than the rest," and positioned exactly vertical to the horizon, could have existed in the original mass from which the column was formed.

From the published photograph and description it seems to me clear that the column is the work of rain, and of rain only; and that wind, and, in a general sense, "weather," had nothing to do with it; and that so far from the capping-stone being an accident, the column owes its existence to it. Such stone-capped pillars are found in greater or less degrees of perfection in various parts of the globe, especially in mountainous districts; they are, I believe, always found in unstratified material containing bowlders or flat stones, always on the flanks of ravines, and always taper toward the top. In several ravines near Botzen in the Tyrol (southern watershed of the Alps) are found hundreds of such columns consisting of indurated mud containing bowlders, varying in height from 20 to 100 feet and usually capped by a single stone. Their mode of formation is described by Lyell in "Principles of Geology," I., 331, and a diagram shows the outline of an original valley excavated in red porphyry, and partly refilled by a glacial moraine, comprising hard, red mud containing bowlders. This mud, after a rain, being heated by the sun, cracks; succeeding rains enlarge these cracks to furrows, and the furrows to gullies, till the material is cut up into a series of columns or pillars. The tops of these pillars are gradually worn off by succeeding rains, until a stone is exposed, which protects the material immediately beneath it, and thus the column is carved out, beginning with the top, so to speak, and becoming longer and longer as the unprotected mud is washed away on all sides. Some are found where large flat stones appear resting on a mere point, giving an umbrella-like appearance; in others the stones have fallen off and the column then wears away rapidly, until, perhaps, another stone is reached which for a while prevents further disintegration. The upper part of the column is always thinner than the lower part, because it has been longer exposed to the action of the rain. Further, the sectional contour of the pillars conforms to that of the capping-stones, and they are therefore like the "Sheepeater's Monument," more often pyramidal than conical.

I have inclosed you a sketch (from the same source) of the "Dwarf's Tower" near Viesch in the canton of Valais (Switzerland), composed likewise of hardened mud and gravel, and capped by angular blocks of gneiss.

I judge that the "Sheepeater's Monument" consists of a similar mixture of indurated clay and gravel and that it is the remnant of a glacial moraine which formerly filled the valley to a point above the level of the capping-stone and in which moraine the existing ravine has been scooped.

As to the senseless name "Sheepeater's Monument" —it would be interesting to know if it were not originally named by its discoverer after Jupiter, whose appellation was subsequently corrupted by the natives into something they could understand.

GEORGE W. COLLES.

Milwaukee, February 23, 1904.

It not infrequently happens that, in any new development, some minor detail gives more trouble than all the rest of the apparatus. In this respect, automobiles are notably weak in two points. Tire troubles are probably responsible for the greatest number of breakdowns, and the tire itself requires constant watching and care. The other weak point is the apparent lack of an entirely reliable igniter. At the recent motor car trials, held in London, England, in September, under the auspices of the Automobile Club of Great Britain and Ireland, no fewer than forty-one per cent of the cars that stopped did so on account of trouble with ignition.—Electrical Review.

TWO INTERESTING ANIMALS AT THE NEW YORK ZOOLOGICAL PARK.

The popular name snow leopard seems almost to involve a contradiction of terms, for leopards, as well as lions and tigers, have always been associated in the minds of most of us with the torrid zone. The popular idea, however, that the larger species of wild animals belonging to the cat kind are confined to the tropics is an essentially mistaken one. Our own big cat, the puma, for example, is at home at least as far north as British Columbia, and extending through every variety of climate, lives as far south as the frigid extremity of Patagonia, thus possessing perhaps the most extensive longitudinal range of any living mammal.

Even the tiger, of which, together with the last-mentioned animal, there are now remarkably fine specimens at the zoological parks, is not supposed to have been originally a tropical animal. Its fossil remains are associated with those of the mammoth in the New Siberian Islands, which are situated well toward the pole within the Arctic circle, and living specimens are yet found as far north as Lake Baikal in Siberia.

But the member of the Felidæ apparently best fitted by nature to withstand a cold climate is without doubt *Felis onca*, the long-tailed or snow leopard. This animal never descends beyond the snow line of the mountains it inhabits. It is associated in the high lands of central Asia with the Siberian ibex, the big-horned argali, and Marco Polo's sheep, animals more or less akin to our Rocky Mountain goat and sheep.

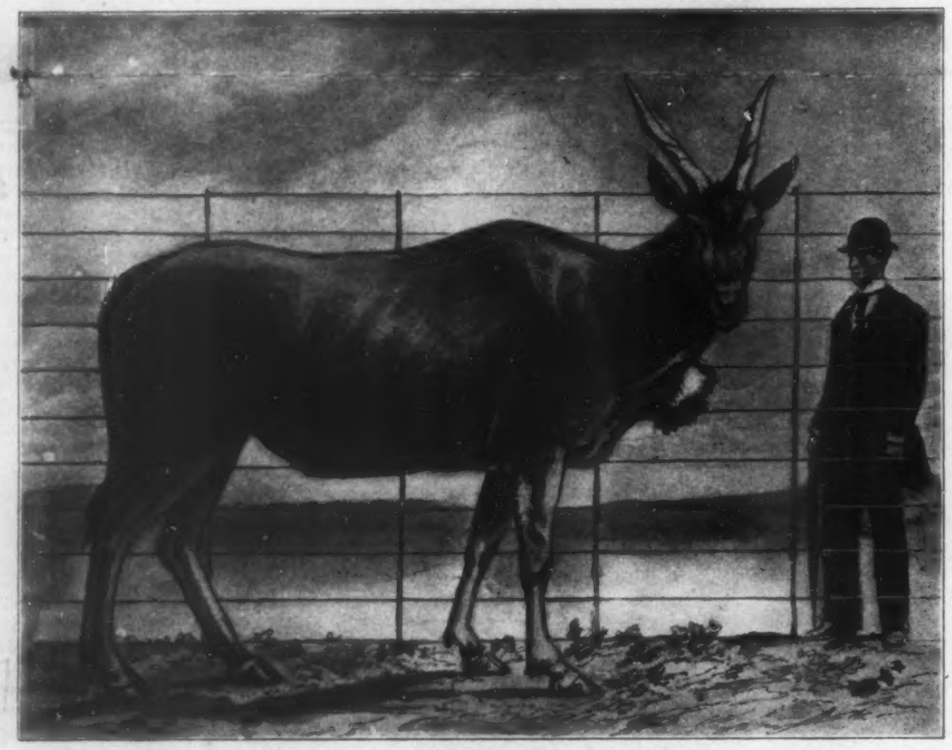
The specimen at the park, a fine male in splendid health and condition, although not yet fully grown, is at least as large as any ordinary leopard, and on account of the long and thick coat of fur with which it is covered, it looks much heavier. Indeed, in this respect it seems to suggest a similar variation from the ordinary type to that exhibited by the long-haired breed of domestic cats when compared with our common fireside pussies.

The color of the snow-leopard is a gray inclining to buff. A few large, dark spots show about the lower parts, and a number of smaller ones congregate about the head and the neck. The back and the sides are marked with faded-looking brown rings or rosettes. The comparatively enormous tail of the animal is fully as long as his body. "Chang" is the first of his species ever seen in this country. He is the sole survivor of four of the species collected by Mr. Hagenbeck's agents in the northern border of Thibet, and is one of the only three snow leopards now in captivity, of which Berlin has one and London another.

Mr. Hornaday, director of the New York Zoological Park, says that sometimes as many as two thousand tanned skins of the snow leopard are brought from the interior of China to Shanghai in a single year, but that "not one live specimen accompanies them. The distance," he says, "is too great, and the difficulties to be encountered with a live animal in a cage are too numerous to tempt even a Chinaman to try to surmount them. Naturally, these animals are very costly; the price of our specimen was nine hundred dollars."

Another late addition to the attractions of the park is a fine large eland (*Oreas canna*), the giant species of antelope that equals an ox in size, reaching the height of nearly or quite six feet at the withers. For all its ponderous proportions, the eland is not an ungraceful-looking creature. The expression is mild, and the head is decidedly of the antelope type. It seems as though such an animal might be domesticated here, as it has been in numerous instances in England. The flesh, when the eland is properly fed, is superior to beef in delicacy and flavor; and certainly an animal that without special breeding puts on a weight of from eight hundred to one thousand five hundred pounds and more, is worth experimenting with. One peculiarity of this magnificent animal should recommend it for the great plains of the Southwest, and that is its capacity of going for a long time without water. The ease with which it is reared, its mild disposition, the fact that it breeds freely in captivity, the great value of its hide as well as of its flesh, and the rapid improvement it shows under scientific cultivation, all conspire to increase the regret with which we see it rapidly approaching extermination in its native country. Few indeed of the wild members of the order of hoofed mammals exhibit so many claims for domestication and preservation by the human race. Particularly is this the case in a country like our own, which includes regions reproducing in so many particulars the character of the particular parts of the African continent included in the range of these giant antelopes.

Long-Tailed Snow Leopard, an Animal that Lives Only Amid Snow and Ice.



The Giant Antelope.

INTERESTING ANIMALS AT THE NEW YORK ZOOLOGICAL PARK.

The Russian Board of Mercantile Shipping and Harbors is working out a project to connect the White Sea, near Soroka, with Lake Onega, near Powyenets, by means of a canal, which would be 135 miles in length, and which would cost £1,320,000.

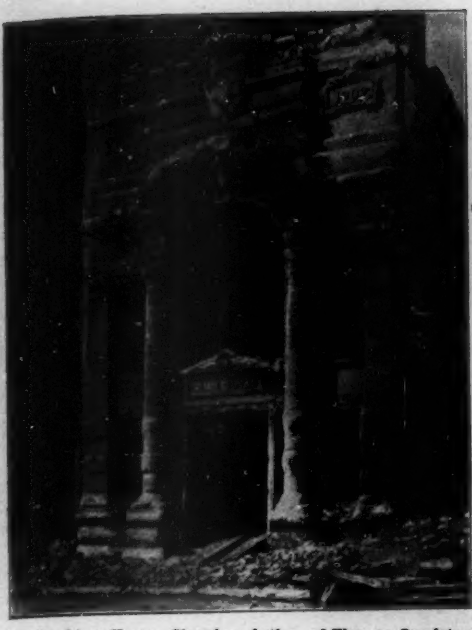
THE LESSON OF THE BALTIMORE FIRE.

BY DAY ALLEN WILLEY.

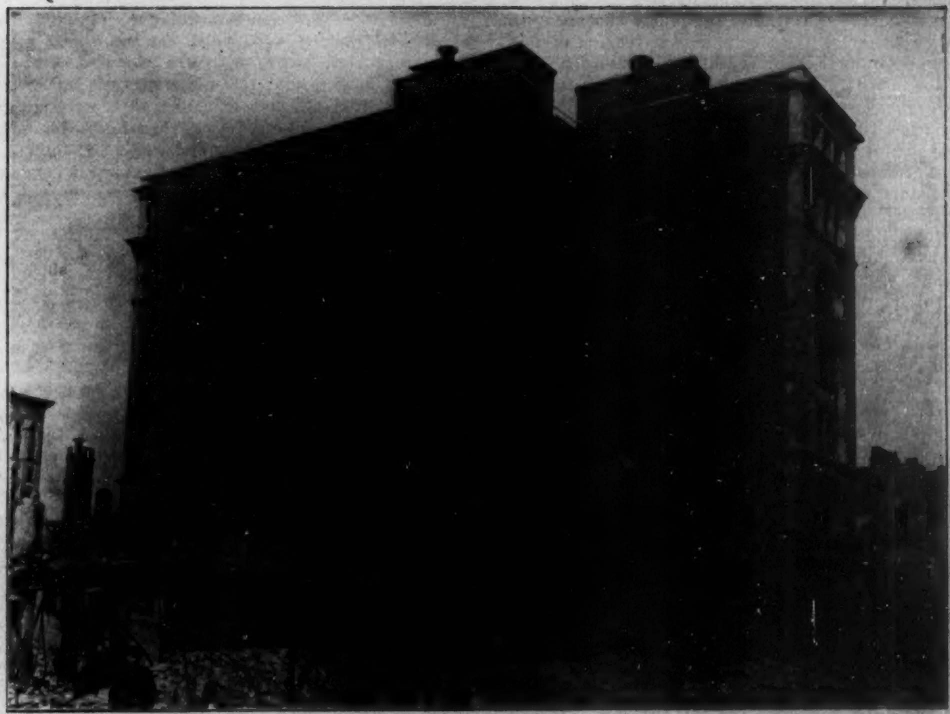
Enough time has elapsed since the conflagration occurred in Baltimore for architects, builders, insurance investigators, and other experts to form an intelligent opinion as to the actual destruction caused, and to draw some conclusion as to the effect of heat and flames on various materials. It is admitted that no fire has ever occurred in the history of the world where a greater variety of buildings were damaged or destroyed; for, as is well known, they ranged in character from small antiquated structures of brick and masonry, two and three stories high, to the modern office building. Especially interesting, however, was the effect of the fire upon bank buildings recently constructed. Within the last few years, more of these edifices have probably been built in Baltimore than elsewhere in the country—buildings designed exclusively for banking purposes, and erected of what was supposed to be the most durable material and provided with the latest appliances which modern ingenuity has devised for protection against fire. Some of these buildings were literally works of art, but one story in height, their exterior composed of massive walls of granite or marble lined with masonry, the framework being of heavy steel girders, and the roof of metal, save where skylights of thick glass were used. Nearly all the skylights, however, were protected by a metallic grating placed a few inches above them. With the exception of the counters and furniture, carpets, and ornamental hangings, the interiors of these banks were supposed to contain no material which would burn, the majority being finished in ornamental metal or stone work with floors of tile, marble, or concrete. With three exceptions, however, these structures suffered as heavily as the others, the interior being literally wrecked. One of the three—the building of the International Trust Company—was principally damaged inside by the wall of the adjacent building falling through the roof, and not so much by the fire. A building recently built by Alexander Brown & Sons had exterior walls of red brick with marble trimmings, being of colonial architecture. Except for the scorching of the walls it was unhurt, although in a portion of the city where the fire was most destructive. The building of the Safe Deposit and Trust Company, also in the heart of the burned district, escaped with slight damage. It was faced with stone, but the masonry lining of the interior was over two feet in thickness.

An examination of the stone ornamental work of the bank and office buildings showed that apparently polished granite withstood the action of the flames and heat much better than the rough surface, although not only granite but marble and other stone was subjected to such a temperature that it cracked off pillars and other portions of the walls in chips, some of which weighed four or five pounds. In fact, the sidewalks around most of the larger buildings were piled with pieces of marble, granite, and brownstone, in some places to a depth of two or three feet. It was noticeable that but little of the terra cotta crumbled away, and most of the brick which fell came down in the walls, but few pieces of brick being detached separately.

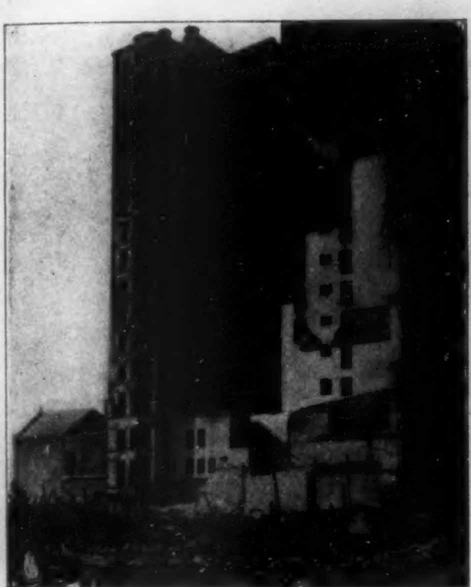
Some peculiar instances of the effect of the heat upon different kinds of stone were noted at the International Trust building, also in the United States bonded ware-



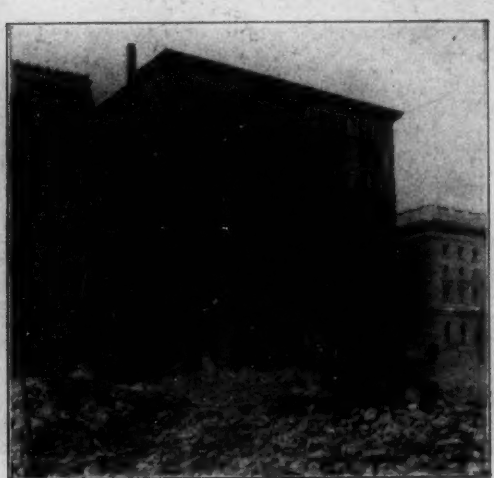
New Banking House, Showing Action of Fire on Sandstone Front.



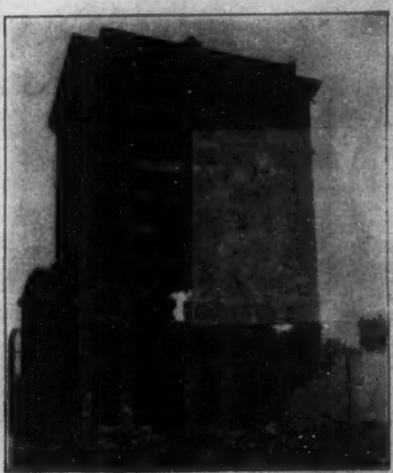
Merchants' National Bank, Showing Sheet-Iron Shutters Burst Open by the Sudden Combustion of Gases Within the Building.



East Side of Continental Trust Building, Showing How Brick Facing was Stripped off by Fire.



The Fire-Swept Equitable Building With the Unharmed Court House to the Right.



Union Trust Building, Showing the Severe Spalling of the Stone Facing.

The Farmers' National Bank Building. The Three Upper Floors (Non-Fireproofed) Burned Out. The First Story (Fireproofed) was Unharmed, Not Even the Glass of Front Door Being Broken.

Maryland Trust Building Left Standing Among the Ruins of Non-Fireproofed Buildings. The Limestone Facing of Three Lower Stories and Terra Cotta Facing of Upper Stories Showed Good Fire-Resisting Qualities.

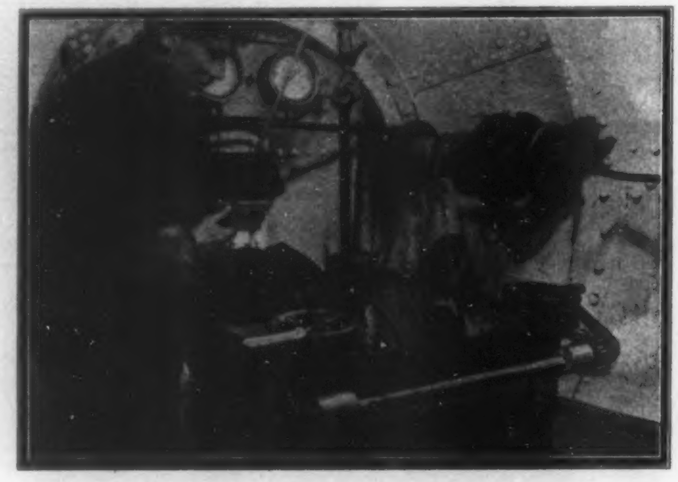
LESSONS OF THE BALTIMORE FIRE.

house. A portion of one of the pillars supporting the front wall of the Trust building was reduced to about half its ordinary size, appearing as if it had been shattered with the mallet and chisel of the stone cutter. The government warehouse, which was one of the oldest buildings in the burned district, was practically unhurt, with the exception of a stone column near the entrance in the interior. The effect of the heat upon this was to chip off its surface, so that it is now only about half its former size. The outside walls of this building, composed of ordinary brick, were practically unhurt, with no cracks appearing in any of them. Over a thousand barrels of liquor were stored in the interior, but so thick were the walls that the temperature did not rise sufficiently to ignite the contents of the building.

One of the most interesting features of the disaster was the way in which the new Baltimore court house checked its progress, although it stood directly in its pathway, and was probably exposed to a greater heat than any other structure. It was separated from the Law building, a seven-story structure, by only forty feet of space. When the Law building ignited, the fire was burning over an area of ten city squares southwest of it. Filled with inflammable material, its interior was soon a mass of flames, which were carried by the air current directly against the upper west wall of the court house, and at times extended thirty and forty feet over its roof. In fact, the fire was directly in contact with the wall for fully a half hour. The interior of this part of the court house was flooded with water, while the walls and ceiling were kept wet. On examination it was found that the window casings were charred, and some of the marble coping which surmounted the wall was broken, while the upper part of the wall was chipped and blackened. Not once, however, did the building ignite inside, owing to its massive construction. The exterior is of Maryland marble, which with the inner lining of masonry gives a thickness to the walls ranging from three feet to three feet six inches. The effects noted, as well as others, have led most of the experts who have visited the burned district to conclude that brick and terra cotta are far better building materials for resisting heat than almost any form of natural stonework; for even the outside walls of the older buildings, as well as division walls, though in many cases completely disintegrated, showed that the brick themselves were but little injured, and the bulk of them can be used for rebuilding if desired. Naturally, the steel framework of the office buildings has been subjected to close study; and although it was feared at first that it was subjected to such intense heat that the strength of the metal would be impaired, and that it would be dangerous to use it as a support for any great weight, such as walls or floors, architects and erectors of steel-frame buildings in general are of the opinion that it is only necessary to remove the columns and girders which were warped and twisted, and replace them, when the structures will be as substantial as before the fire. Instrumental measurements show that none of the larger buildings are out of the perpendicular line. In all cases, however, it is agreed that the interiors must be entirely renewed. In many instances arched floors have either crumbied away or are so badly broken that they must be rebuilt. Much of the flooring consisted of a form of fireproof concrete laid upon the steel girders, and finished with tiling of marble and terra cotta. In the Union Trust and some other office buildings, most of the flooring fell through to the cellar. In the buildings where it remains, it is so loosely attached that nearly every day since the fire, portions have been falling, sections of three floors giving way unexpectedly in the Equitable building a week after the fire had been extinguished.

The leaders of the Baltimore fire department, as well as insurance men and others familiar with conflagrations, have advanced some interesting theories as to the remarkable rapidity with which the fire spread over the burned area. When it started, the wind was not blowing a gale, as has been stated. In fact, its maximum velocity was not over thirty miles an hour at any time during the day. It is unnecessary to say, however, that as the number of burning buildings increased, and heat was generated in proportion, a draft was caused in the immediate vicinity of the fire, which possibly represented a gale in the force of the air current.

This artificial wind, as it might be termed, of course was blown toward the north and east, since it was aided by the ordinary breeze which came from the southwest. An enormous volume of hot air was driven ahead of the fire as the result of the atmospheric disturbance, and it is believed this had much to do with the spread of the conflagration. In fact, the heat was so great, even where the fire was confined to a single block, that persons on the roofs of buildings 500 and 600 feet away were unable to face it, and were obliged to leave them. When the flames had reached the financial district, shortly before midnight, and the Continental, Baltimore & Ohio, and the Equitable buildings were on fire at the same time, it was impossible for any one to go within a square of this section, on account of the temperature. Consequently, it was absolutely impossible to attempt to throw a stream of water upon the fire from the north or east of these buildings, and many times during the day the firemen could not even reach the edge of the burning territory for the same reason.



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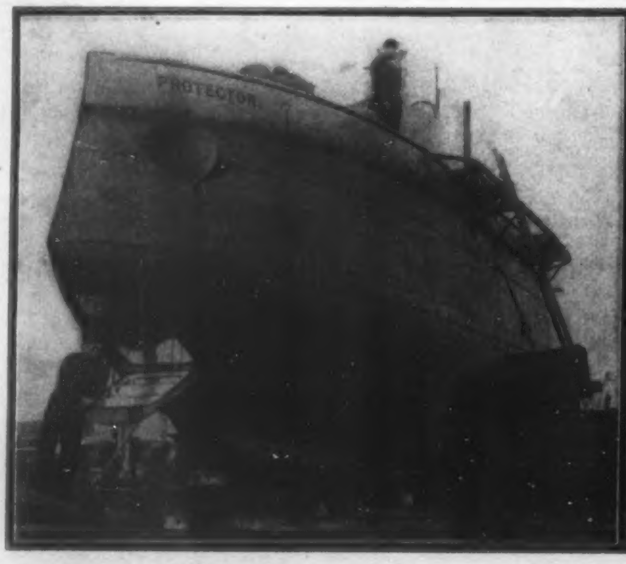
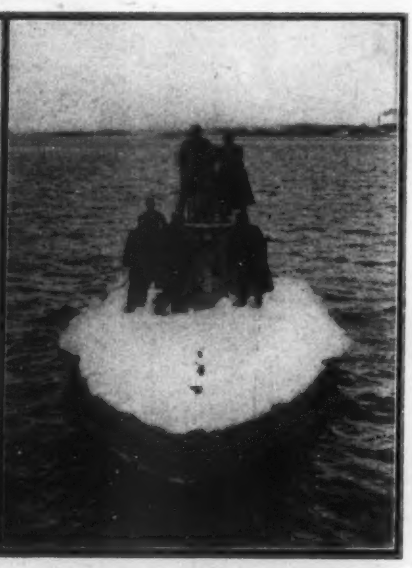
The Diving Compartment, Showing Windlass and Grapnel Bringing up a Cable from the Sea Bottom.





Photos Copyright 1904 by R. G. Skerret.

The "Protector" in Drydock, Showing Diving-Compartment Door Open.

The Ice-Covered "Protector" After a Run.

Army Board members on the deck and conning tower.

The opinion has been advanced that in many cases the volume of superheated air actually set fire to structures 300 and 400 feet beyond the limit of the flames. The writer and other observers noticed several instances where buildings ignited in this way some time before the main fire reached them, flames and smoke issuing from the interiors, and not from the roofs. It might be said here, that as soon as the extent of the conflagration was realized, forces of men were sent to the roofs of all the buildings throughout the business district for a half mile or more around the burned area, in order to prevent them from being ignited by the quantities of sparks and cinders. In nearly every instance the efforts made in this way with buckets of water, brooms, and sprinkling hose were successful, and thus far no other cause has been given for the manner in which some of the isolated buildings caught fire, except the action of the hot air penetrating the interiors.

Another proof of this theory is shown in the way buildings protected by "fireproof" shutters were affected. The rear wall of the Merchants' National Bank building was completely protected in this manner, every window being guarded by shutters of sheet metal, which were closed and barred on the day in question. A number of the large warehouses on Hopkins Place were also provided with shutters of the same kind, yet in nearly every instance they were burst open, apparently from some force within, and in a number of cases the opening of the shutters was followed by flames shooting from the windows, although no signs of fire were visible on the other sides of the buildings. An examination of the Merchants' Bank building on the day following the fire showed that every shutter had been forced open as stated.

It is generally acknowledged that only a change in the direction of the wind saved a much larger portion of the city from being destroyed, as the change turned the wave of fire and hot air southward, where it terminated on the harbor front. In the study of its ravages, the question has arisen if destruction of similar or even greater magnitude would not result in other cities, if the conditions were similar to those in Baltimore.

It is admitted that "skyscrapers" had little or no effect in checking the progress of the fire, and when it was once ablaze it could not be approached near enough for the firemen to do any effective work.

The Baltimore buildings, it is believed, were constructed as solidly and substantially as the average office buildings in New York, Philadelphia, or Chicago. In the latter cities these great structures are more numerous and built more closely together than in Baltimore, and many of the insurance officials especially are of the opinion that a fire in one of the cities named might do even more damage, if it passed beyond the control of the fire department.

OFFICIAL TEST OF THE LAKE SUBMARINE BOAT "PROTECTOR."

The test of the submarine boat "Protector," made by an Army Board recently, is fully described on another page. The accompanying illustrations show the appearance of the boat after rising under a huge cake of ice 8 inches or more in thickness; the interior of the diving compartment; and the bow of the boat when in dry dock. The last-named is the most striking picture. In it, the boat's prow has the appearance of a huge, sinister face. The torpedo tubes appear to be the eyes; the bow anchor-weight hole, the nose; and the door of the diving compartment, the mouth of the huge sea monster. The interior view of the diving compartment shows the grapnel bringing up a cable through the door in the floor. The windlass at the side is used to haul up the grapnel after it has picked up a cable. The small rectangular glass in the front of the compartment is for looking at the bottom without opening the compartment door. The tube from this glass leads into the anchor weight hole in the bow, and so this window can only be used when the weight is out of its casing. The diving compartment is the great feature of the Lake submarine that distinguishes it from all others. The picture of the ice-covered boat tells its own story and shows that the new submarine is ice as well as waterproof, and could be used for breaking a channel by running under the ice and coming up under it, if it could be done in no other way.

The first discovery of coal in the United States recorded in history was in 1679, at a locality near the present city of Ottawa, Ill.

QUEER HIDING PLACE FOR BEES.

BY HELEN LUKENS JONES.

During mountain tramps it is not unusual to find bee nests in the hollow trunks of trees and in other odd places, but they are seldom discovered nesting among the rocks in the picturesque fashion illustrated by the accompanying photograph. This particular swarm was found in the Sierra Madre Mountains back of Pasadena, California, where in the seclusion of a rocky wilderness they were accumulating stores of sweets without fear of human intrusion or human theft. They had a well-stocked establishment with rock walls, rock roof, and rock foundation. It was a home impervious to rain or wind. The busy workers had certainly shown clever foresight in their selection of a home, for it was situated some distance from the beaten trail, and being surrounded by a dense copse of brush, grasses, wild sage, and yucca, was as nearly isolated as it could possibly be. White sage and black sage, the most prolific honey-producing plants in Southern California, grow luxuriantly in this locality. The bees have not far to go to the honey market for their load of sweets, and in the cañon a few rods below is a brisk mountain stream where they can drink. This bee cave extends back into the cliff about four feet. The entrance is four feet in width and eighteen inches in height. It is completely filled with combs, the bees having hung their honeyed tapestry to the very threshold. This hermit swarm was composed of fine, full-blooded Italians that had undoubtedly escaped from some mountain apiary.

Are the Canals of Mars Illusions?

In Knowledge, Mr. E. W. Maunder and Mons. E. M. Antoniadi both contribute illustrated articles to show that the Martian Canal system, as figured by Schiaparelli and others, is largely an illusion. Mr. Maunder has made experiments at the Royal Hospital School at Greenwich and thus describes the results: "A class of about twenty boys, from twelve to fourteen years of age, were seated in four or five rows at different distances from a carefully-lighted diagram, which they were told to copy. The diagram was reproduced from some published drawing of Mars, but in nearly every experiment the canals were omitted. The diagram was generally about six inches in diameter, and the distances of the boys from the diagram ranged from fifteen to forty feet, except in two experiments where the range extended up to sixty feet. . . . The general result was striking. In several of these experiments nearly all the boys drew "canals" on their copies, though there were none on the original from which they were copying. And these "canals" were not placed at random; they were just in the very places where canals are seen in the charts of Schiaparelli and Lowell. . . . . Whence then did the "canals" come which were drawn by the boys of the Hospital School? One cause was the prolongation of dark indentations invading the brighter regions. . . . A more fruitful source of the "canals" was the introduction of regions slightly darker or slightly brighter than their surroundings. Meroe Island figured as an example in the first category, Elysium as one in the second, in two different experiments. And no one could wish for straighter and sharper "canals" than were drawn by a good proportion of the boys to express these regions. . . . But the cause which was the most effective within the limits of our experiments with the Hospital School boys was the way in which the eye summoned up together minute irregular markings, each too small to be separately perceived as straight streaks. . . . The general distribution of the true markings on the planet must approximate to that shown on the charts of Schiaparelli and Lowell, and the details if not straight lines in their ultimate conceivable resolution are at least straight lines to the eye. But the gain is really great. For so long as we conceive of that elaborate reticulation as being a true feature of the actual surface of the planet, we can hardly escape from Mr. Lowell's induction. Lines so straight, so formal, so uniform in width, so regular in their intersections, so symmetrical, with dark spots so inevitably marking their intersections, must be accounted, as he accounts them, artificial; the handiwork of intelligent beings. But if actual details of perfectly irregular and unsymmetrical character, details having no sign of artificiality about them, can present exactly the appearance, and make just the impression which the network of the canal system does, the argument for the existence of inhabitants on Mars has vanished. We are freed, too, from the necessity of considering such bizarre theories as would make out the planet to have been scored into its present form by grazing meteorites, or to have assumed it through crystallization. To have been set free from the grotesque in observation is to have been freed also from the grotesque in speculation. This service I think the drawings of the Hospital School boys have effectually rendered to us. They have shown that perfectly unbiased observers will see and draw the Schiaparellian canals when the actual markings presented to them are as little regular and artificial as any which our own earth might present to an outside spectator."

REMARKABLE BEE'S NEST IN THE MOUNTAIN ROCKS.

Technical Schools in Germany.

Of the total of 3,610 students in the German technical schools for the year 1902 no less than 1,359, or 37.6 per cent, were foreigners. This is a very heavy percentage of foreigners, and surpasses the percentage at the technical universities, which generally ranges from 10 to 30 per cent. At the Mining High School at Freiberg, the number of foreigners is still greater; in 1901 there were 280 foreigners to 186 Germans.

RECENTLY PATENTED INVENTIONS.

Heating Appliances.

MUFFLE.—J. CARTER and A. G. CARTER, Malden, Mass. Fires being lighted in the fire-holes by means of fuel resting upon the grate-bars, the smoke and gases of combustion pass upwardly through all of certain passages to a chamber and downward through a central flue. Arriving at the bottom the smoke and gases radiate, then pass upwardly through passages, deflect through arches, pass through more passages into a stack and escape. Upward drafts are arranged alternately with other upward drafts. Air is drawn inward and divided and distributed to flames at points above the bars. The device acts somewhat in a smoke-consumer capacity, causing combution, saving fuel, and distributing heat.

ASH-DOOR.—E. C. COLE, Chicago, Ill. The object of this invention is the provision of a novel construction of connection between the stove-section and the cover-section of such door, whereby the cover-section can be conveniently applied to and removed from the stove-section and will be properly hinged in connection therewith when applied, and to so construct the parts that the fitting or bearing surfaces between the two sections can be conveniently ground on emery or other grinding wheels to a true surface.

Machines and Mechanical Devices.

MEANS FOR ARRESTING ELEVATOR CARS.—P. F. HALLOCK, Detroit, Mich. In the present instance the invention has reference to means for arresting the cage or hoist of an elevator in case of accident, and the object that Mr. Hallock has in view is the provision of simple devices adapted to be easily and cheaply supplied to existing or newly-installed elevators, and capable of service in a way to check and arrest a swiftly falling loaded car without injury to the apparatus and its load.

MOLDING-MACHINE.—J. J. TURNER and J. A. DOWLER, Laharpe, Kan. This improvement has reference to machines for forming vessels of plastic material, such as condensers made of clay and used in retorts employed in zinc smelters. The object is to provide a molding-machine which is simple in construction, easily manipulated, and arranged to allow of forming the vessels of uniform size and shape without requiring the employment of skilled labor.

GLASS BLOWING AND FINISHING MACHINE.—J. SCHIES, Anderson, Ind. In this patent the invention is a combined blowing and finishing machine designed to take the bottle as it is delivered from the press-molds of an ordinary glass-machine to finish the mouth thereof and to produce an internal groove within the neck of the bottle at one operation.

TAPPET FOR STAMP-MILLS.—E. I. MOREY, Telluride, Col. In this case the invention's object is to provide a tappet so constructed as to be readily adjusted lengthwise of the stem and also to be adjusted to the possible reduction of circumference due to the wear of the stem in moving in its guides, and, further, to so construct a tappet that it will be practically impossible to displace it when locked in place.

LUBRICATOR FOR YARNS OR THREADS.—C. J. LEHMAN, dec'd, New York, N. Y.; PAULINE LEHMAN, administratrix. It is necessary to apply a lubricant to yarn or thread while it remains in winding machinery—as, for example, when it passes from a reel to a spool—and to accomplish this end the inventor has devised a device employing a lubricant in a solid form as distinguished from a bath of liquid lubricant, thereby securing economy in the quantity used in treatment of the threads, these being of any weight and color and of any material such as wool or cotton.

STITCH-FORMING MECHANISM.—E. C. HENDERSON, Pictou, Nova Scotia, Canada. To the end that a lock-stitch may be formed without the use of a shuttle and its appurtenant parts, this mechanism comprises a needle carrying the needle-thread as usual, a guide adapted to carry a second thread to complete the formation of the lock-stitch, and a hook or other means for drawing the thread from the guide, these elements being constructed and arranged in a certain novel manner.

OFF-BEARING MECHANISM FOR SAW-MILLS.—E. T. DAVIES, Portland, Ore. Of several objects in view in this invention Mr. Davies has particularly one in the provision of a mechanism which will engage with the stick or plank as fast as it is sawed by the sawing mechanism of the mill and will remove the plank from the main block of timber or the cant and deposit the same on the carrying or conveying device of the machine or saw-mill. It is capable of being applied to any of the well-known forms of sawing-mills now in use.

Of Interest to Farmers.

CULTIVATOR.—W. J. LUTTRELL, Honeygrove, Texas. In this invention the improvement is in that class of wheel-cultivators in which the shanks or foot-pieces carrying the shovels are attached to a saddle or cross-head on the draft-beam in such manner as to permit the said shanks or foot-pieces to be adjusted at different angles to the surface or to the line of draft. There are means for attaching the foot-piece to the cross-head, whereby it may be adjusted and clamped at any angle with great facility.

BUTTER-PRESS.—F. MURPHY, Lisbon Center, N. Y. One of the principal objects of this invention is the provision of devices or means by which a plurality of prints of butter or like substance may be molded at one and the same time, each possessing the desired shape, dimensions, and weight, as well as having thereon an impress of any suitable design.

BROODER.—S. FUSTON, Murfreesboro, Tenn. In this apparatus the object is to supply heated fresh air plentifully with a minimum expenditure of oil. The brooding casing is constructed in two compartments, one lower than the other, and with a door hinged at its lower end, so it can be turned down to form an inclined runway from the upper to the lower compartment or can be turned up to form a separating-wall between the two compartments. The great advantage secured is the thorough warming of the body of the chick while giving it comparatively cool fresh air to breathe.

Railways and Their Accessories.

DEVICE FOR RELEASING TRUCKS FROM CARS.—R. L. RILEY, Newburgh, N. Y. Trucks ordinarily are connected to a car-body through the medium of a large bolt or pin, termed a "king-pin," and in order to remove this pin and disconnect or remove the truck from beneath a car-body it is necessary to enter the car and pull the pin from its socket, and this is inconvenient when the car is heavily loaded, as the cargo adjacent to the pin-socket must be shifted to have access to the king-pin. With this invention the pin may be easily removed without entering the car and without disturbing the contents. Should the cargo consist of a granular substance small particles will not drop through the casing and interfere with the operation of the pin-releasing device.

Miscellaneous.

ICE-MAKING APPARATUS.—H. STOUT, Kingman, Kan. The principal object in this invention is to provide a water-freezing apparatus or plant for the manufacture of ice which is comparatively inexpensive to construct, which is reliable in operation, easy of access and control, and not liable to get out of order. The apparatus or plant may be constructed on a small or a large scale, and may include a single water-compartment only or a series of such compartments, and any suitable material may be employed. It may be rectangular in shape and of any desired height and other dimensions.

HORSESHOE-PAD.—J. F. ROBINSON, Rockaway, N. J. The purpose of this improvement is to provide a pad which is almost entirely constructed of comparatively soft rubber or like clinging and yielding material and to provide suitably placed and concealed metal stays, either removable from the body of the pad or immovably placed therein by reason of the body of the pad being molded or cast around the stays.

LEMON-SQUEEZER.—A. MCLAREN, Fort Worth, Texas. The squeezer cuts and squeezes a lemon with one operation. The invention consists, in peculiar means adapted to strain the juice, and, further, of peculiar devices automatically operating upon upward movemen. of the squeezing-lever to discharge the squeezed portions of the lemon.

MEANS FOR HOLDING PIANO TUNING-PINS.—G. RUCKSTUHL, Rutherford, N. J. Owing to successive tuning of a piano and continued strain of the strings the pins work loose and enlarge the holes in the pin-block. Mr. Ruckstuhl's object is the provision of means for protecting the pin-block and for securely holding the tuning-pins in their adjusted positions, said means dispensing with the usual dowels and holding the pins and strings in a way to avoid the production of metallic tones when the keys are struck.

POMADE-CAN.—E. L. PITTS, Jerome, Arizona Ter. Mr. Pitts' improvement is designed especially for use by barbers for holding pomade, vaseline, or the like, and has for an object the provision of a simple, novel construction whereby the user may be able to procure the desired amount of the pomade or vaseline from time to time. The device will hold various kinds of jellies, salves, etc., and will permit convenient removal thereof in any quantities, and is able to exclude all dust and dirt in a simple manner.

AMUSEMENT DEVICE.—A. G. HAMMELL, New York, N. Y. The purpose in this invention is to provide a structure upon which cars or vehicles are drawn up an inclined plane by a cable or the like and relieved from the cable when the upper portion of the incline is reached and to construct a spiralway or track leading from the upper point of the plane, where the vehicle is released, the contracted portion of the spiral being its lower portion, whereby as the vehicle descends the way the occupants will experience sensations as when drawn into a whirlpool.

NEEDLE-CUSHION SPOOL.—M. DUNCOMBE, Wattsburg, Pa. The object of this invention is to furnish thread-spools or bobbins with an improved attachment for receiving and supporting sewing and other needles while not in use. The improvement may be applied to spools or bobbins adapted for holding yarn as well as sewing thread and the cushion may in some cases be inserted in a bore or socket formed in the spool outside of or eccentrically to the bore and made in any form, cylindrical or square, etc.

BOILER-BRACE.—J. A. PEMENT, Chicago, Ill. The invention relates to steam-boilers; and the inventor's object is to provide a new and improved brace, more especially designed for use between the shell and the head of a boiler and arranged to prevent the brace from arching or buckling upon subjecting the boiler to heavy pressure. No matter in what direction the strain comes on the brace, the brace properly fulfills at all times its functions, with the great advantage of rendering the boiler very strong and safe.

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Inquiry No. 5246.—For makers of calculating machines.

Inquiry No. 5247.—For makers of woven and printed labels and straps for shoes.

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Inquiry No. 5249.—For a machine for printing on lead pencils.

Inquiry No. 5250.—For a Taylor calculating machine.

Inquiry No. 5251.—For makers of level glasses.

Inquiry No. 5252.—For makers of lathes, planers, drill presses, gasoline engine, castings and automobile parts.

Inquiry No. 5253.—For a machine for imparting power to churn dashers, washing machines, also makers of corn-husking machines operated by hand.

Inquiry No. 5254.—For makers of dish-washing machines.

Inquiry No. 5255.—For makers of typewriters ranging in prices from $35 to $40.

Inquiry No. 5256.—For makers of handles for rakes, forks, etc.

Inquiry No. 5257.—For a covered automobile carrying 12 to 16 persons.

Inquiry No. 5258.—For broom-making machinery.

Inquiry No. 5259.—For a small model ¼ h. p. steam engine boiler for demonstrating purposes.

Inquiry No. 5260.—For makers of papier maché toys.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending March 1, 1904.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Abrading device, P. Ekvall 753,251
Acids and bromated phtalic acids with naphtols, making condensation products from dicarbo, Denguine & Levinsohn .. 753,372
Adding and subtracting apparatus, automatic, N. H. Kodama 753,586
Adjustable wrench, A. Heberer 753,489
Advertising cabinet, M. Kovacevic 753,587
Air brake controller, J. C. Wands. 753,648 to 753,650
Air compressor, C. S. Dean 753,787
Air compressor governor, H. Saam 753,633
Amusement apparatus, L. A. Thompson 753,449
Anchor, W. Hector 753,394
Anglers' artificial flies, apparatus for storing or carrying, G. A. Pickard 753,300
Anthracene derivative and making same, R. Bohn 753,659
Armature winding, J. F. McElroy 753,422
Axle, W. P. Wilcox 753,816
Baling press, W. F. Jacobs 753,402
Ball. See Billiard or pool ball.
Ball and socket fastener, J. R. Smith 753,525
Bank, savings, I. D. Perry 753,300
Baskets or cases, apparatus for cleaning bottle, R. Knollner 753,500
Bean picking machine, G. F. Crippen 753,370
Bearing, antifriction, W. W. O'Connor 753,619
Bearing, antifriction, W. C. Baker 753,820
Bed construction, couch, F. M. Tinkham 753,760
Bed, spring, I. H. Haas 753,698
Bedstead brace clamp, F. H. Childs 753,362
Beer cooler coils, device for protecting, J. Thoemling 753,450
Beets, machine for blocking sugar, J. H. Uhl 753,451
Bell, N. W. Crandall 753,369
Bells, making, J. T. Duff 753,248
Bending device, T. Damm 753,553
Bending machine, J. F. Martin 753,801
Bevel, W. V. Morrow 753,419
Billiard or pool ball, Haskell & Brigham .. 753,392
Binder, loose leaf, A. Opalla 753,805
Blackboard machine, W. T. Jordan 753,829
Boat, metal, S. D. Noel 753,425
Boiler drying attachment, W. B. Swartwout 753,446
Bolt threading head, W. Rievaldt 753,739
Book carriage, Goodman & Wurtele 753,484
Book handle, G. Koch 753,585
Book rounding, backing, and lining machine, C. W. Lovell 753,413
Boot or shoe, J. Keats 753,495
Borer, post hole, M. P. Curlee 753,239
Bottle, A. Friedmann 753,564
Bottle closure, A. Gaul, Jr. 753,254
Bottle filling machine, P. J. Cawley 753,236
Bottle, non-refillable, Peterson & Hutchins. 753,306
Box, B. vom Eigen 753,381
Box covering machine, H. B. Smith 753,524
Brake lever attachment, R. W. Cooke 753,549
Brush holder, C. O. Bulock 753,356
Brush making apparatus, hair, W. W. Carpenter 753,234
Buckle, R. Scheuer 753,320
Buckle, suspender, L. Neuberger 753,424
Buggy boot holder, S. Pearson 753,428
Building block, J. D. Morrison 753,286
Building block, A. F. Hoffman 753,491
Building blocks or stones, machine for molding, W. L. Dow 753,377
Bung for barrels, etc., valved, J. E. Phillips 753,308
Burglar alarm, C. H. De Voll 753,244
Burnishing wheel, G. W. Kimball 753,497
Button and button fastening, combined, G. W. McGill 753,612
Calendering machine, C. E. Torrance 753,761
Camera, G. C. Beidler 753,351
Camera bed, H. W. Locke 753,800
Cameras, multiple view back for, A. E. Lipp 753,279
Can breasts, attaching hoops to milk, A. T. Kates 753,580
Candy kisses, etc., machine for wrapping, S. M. Hamblin 753,571
Candy pulling machine, J. C. Breckenridge. 753,353
Cane cutting and stripping machine, A. C. A. Dupuy 753,558
Canteen, T. J. Pratt 753,516
Car bolster, A. C. McCord 753,289
Car bumper and coupling, mine, J. M. Phillips 753,623
Car door, G. W. Kellogg 753,496
Car door, grain, J. G. Sanborn 753,811
Car draft rigging, E. C. Washburn 753,454
Car, dump, O. W. Meissner 753,506
Car handling apparatus, L. L. Logan 753,719
Car, hopper bottom, J. M. Ames et al. 753,653
Car safety guard, electrical, C. A. Willard .. 753,341
Car seat, E. Chamberlin 753,545
Car stake, A. H. Speir 753,643
Car, triple hopper coke, J. M. Hansen 753,257
Car underframing, railway, G. I. King 753,583
Cars of all kinds, safety apparatus for motor, K. Schmidt 753,436
Carbon resistance and producing and adjusting same, G. I. Leonard 753,716
Cart, self-loading, J. F. Clark 753,669
Case. See Packing case.
Cash register, W. H. Muzzy 753,512, 753,513
Cash registering and checking apparatus, J. M. Carson 753,235
Cattle guard, Baillie & Anderson 753,220
Cement block mold, W. G. Park 753,303
Cements, maturing Portland or other hydraulic, H. A. Gerdes 753,385
Chart, skirt, L. Davis 753,680
Check controlled apparatus, Caldwell & Martin 753,823
Check, voucher, W. J. Fabian 753,480
Chloroform, making, A. W. Smith 753,325
Chuck disk, J. L. Johnson 753,275
Chucking machinery, C. Prouty 753,430
Chute, portable and adjustable stock, A. B. Copley 753,833
Cigar cutter and lighter, Coombs & O'Connell 753,672
Cigar displaying and vending device, G. H. Hagar 753,827
Circuit breaker, automatic magnetic, F. O. Hartman 753,704
Clevis, B. W. Cook 753,366
Clock dials, marking watchmen's A. A. Newman 753,615
Clock, electric alarm, L. H. Cushman 753,240
Clock, self-winding electric, Talcott & Kerr 753,757
Clothes line hanger, R. Alpin 753,218
Coal separator and washer, H. M. Spencer 753,440
Cock, automatic stop and waste, J. T. Hutton 753,271
Collar and necktie retainer, O. F. Amburn 753,784
Collar, horse, H. Sellon 753,437
Comb cleaner, F. P. Bjorncrantz 753,225
Composing machine justifying device, J. A. Watson 753,336
Composition of matter, W. A. Price 753,310
Composition of matter, W. Lenderoth 753,407
Concrete bricks, etc., apparatus for the manufacture of, L. J. Dumm 753,249
Condenser, Douglas & Conroy 753,555
Condenser, locomotive tank, Burger & Williams 753,357
Condenser, steam, R. W. Knapp 753,404
Condensing apparatus, steam, H. A. Doe, Jr. 753,247
Conveyer, M. Foshee 753,482
Conveyer or chute for infilling material, T. Nicholson 753,616
Cooling rack for bars, G. G. McMurtry 753,293
Cooling tower, C. F. Hettinger 753,573
Coop, chicken, H. R. Bridgers 753,226

Copper pouring spoon, B. H. Bennetts 753,465
Copy holder, B. Hill 753,490
Corn husking implement, H. Schuster 753,639
Corn husking machine feeder, A. Yates 753,346
Cot or lounge, reclining, White & Miller .. 753,815
Cotton gin and condenser, E. W. Hays 753,488
Cows, antikicker for, J. Casey 753,359
Crate, banana, M. Lombardo 753,410
Curtain pole, D. Brehm 753,821
Cuspidor, Burns & Casteel 753,229
Cutter bar alinement, G. Wilson 753,459
Cutter head, F. Stutzman 753,528
Cutting irregular forms, knife carrier for machine for, A. M. Stickney 753,444
Davenport and couch, combination, A. L. & G. C. Hartshorn 753,487
Decorticating machine, W. H. Allison 753,652
Dental bridge, F. Teague 753,529
Dental impression cup, adjustable, J. C. Davis 753,679
Derrick, C. R. B. Claflin 753,237
Disinfecting attachment, telephone, C. Bravi-Bertini 753,466
Disintegrating machine, W. A. Parry 753,304
Distilling apparatus, wood, W. C. Douglas .. 753,376
Dividers, proportional, A. Basola 753,221
Door frame, screen, J. Schnettler 753,637
Door lock, J. Sliga 753,642
Door, removable, J. R. Hussey 753,578
Draft equalizer, J. H. Emert 753,382
Drawing board, T. L. Austin 753,463
Dray seat and truck, combined, J. D. Stewart 753,442
Drier. See Fruit drier.
Drying and calculating kiln, C. E. Pickett .. 753,624
Drill, J. M. Martin 753,503
Drill pressure regulating mechanism, W. A. Van Brunt 753,452
Drilling machine shot feed apparatus, W. S. Easton 753,379
Dye and making same, anthracene, O. Bally 753,657
Eaves trough cleaner, G. W. Boyer 753,660
Egg or fruit tray, Wilson & Baker 753,343
Electric conductors, combination bracket and knob for, E. C. Hunt 753,399
Electric meter, T. Duncan 753,559
Electric switch, G. W. Hart 753,258
Electric wiring cleat, E. C. Hunt 753,398
Electrical conductor and coil, J. C. Anderson 753,461
Electrical conductor conduit, H. Krantz 753,714
Electrical connection, E. G. Thomas 753,759
Electrical machines, winding for, F. J. Lindeman 753,278
Electrode, G. J. Atkins 753,819
Electrodes for storage battery cells, preparing, O. Frank 753,383
Electrodynamic generator, G. M. Pelton 753,429
Electromagnetic signal, W. U. Colthar 753,365
Electrotherapeutic device, C. K. Munns 753,509
Elevator door locked controller, C. O. Harker 753,572
Elevator retarding device, automatic, C. P. Hall 753,569, 753,570
Embossing machine supporting roller, A. Bresemann 753,662
Engine driving mechanism, traction, H. C. Cloyd 753,670
Engine igniter, explosive, A. A. Low 753,280
Engine igniting device, explosive, B. Botkowski 753,226
Engine sparking device, gas, G. J. Murdock 753,511
Engines, electric sparking igniter for explosive, W. J. Hart 753,795
Engines, means for attaching suction tubes or inlet valves to explosive or internal combustion, L. B. Smyser 753,814
Envelop, L. C. Vanderlip 753,333
Envelop machine, S. A. Grant 753,256
Evaporating apparatus, multiple, W. Witkowicz 753,777
Excavating and loading machine, D. H. Mahoney 753,282
Excavating machine, rock, C. T. Drake .. 753,477
Eyeglass mounting, E. Clark 753,364
Fan, S. D. Earl 753,687
Faucet, lock, B. R. Bacon 753,349
Faucet spout, sheet metal, W. S. Stapley .. 753,749
Feed trough, knockdown, E. J. Ingwersen .. 753,400
Fence, P. M. Bounds 753,227
Fence post, A. Adam 753,347
Fence post, W. R. Bordner 753,467
Fiber cleaning machine, M. Prieto. 753,628, 753,736
Filter, Voindrot & Boillot 753,453
Filter and purifier, water, W. Woods 753,780
Filtering apparatus, C. E. Geiger 753,696
Fire escape, J. E. Smith 753,326
Firearm, automatic, C. R. S. J. Halle 753,700
Firearm, breakdown, F. A. Hollenbeck 753,492
Firearm, breechloading, P. Frazier 753,384
Fireproof building block and slab, R. Illemann 753,707
Fish cleaning machine, Manula & Carlson. 753,722
Floor boards, making, E. J. Fulghum 753,791
Flower pot support, W. D. Gridley 753,485
Fluid materials, machine for filling vessels with, G. A. McAllister 753,606
Folding table, A. W. Brightwell 753,663
Food composition, E. Dreiss 753,685
Fruit drier, A. A. Quarnberg 753,737
Fuel, H. R. Dorr 753,246
Furnace. See Metallurgical furnace.
Furnace, D. A. Ebinger 753,250
Furnace, F. Gorman 753,793
Furnace air feeding device, G. W. Brown .. 753,664
Furnace grate, F. H. E. C. Nehse 753,298
Furnaces, apparatus for feeding fine fuel and air to, A. E. Creigh 753,673
Furniture, cushioned foot for metal, J. F. L. Uhl 753,762
Galvanizing plants, cooling rack for, W. Gibson 753,255
Game apparatus, C. P. Edmunds 753,561
Garment, J. A. Scriven 753,322
Garment adjuster or holder, J. Wilson Haffenden 753,775
Garment hanger, N. C. Terry 753,448
Garment pressing machine, F. Lindsay 753,596
Garment protector, D. W. Curtiss 753,474
Gas engine, G. J. Murdock 753,510
Gas engine, J. M. Stadel 753,527
Gas generating apparatus, acetylene, G. J. Atkins 753,818
Gas generator, acetylene, C. & J. Tatters 753,447
Gas generator, acetylene, E. M. Rosenbluth 753,632
Gas generator, acetylene, J. M. & P. M. Flugstad 753,691
Gas lighting mechanism, time, F. W. Thielenhaus et al. 753,330
Gas, making, P. Naef 753,295
Gas making apparatus, P. Naef 753,296
Gas or gasolene engine, G. W. Fulkerson 753,483
Gas or other fluid meters, coin freed mechanism for, Beale & Bagnall 753,658
Gas producer, J. M. Wight and H. Hyatt .. 753,340
Gas, producing, P. Naef 753,294
Geometrical figures, instrument for the construction of equivalent, J. C. Willmon .. 753,458
Glass stone, manufacture of, L. A. Garchey 753,694, 753,695
Glove, G. E. Woodman 753,779
Gold from rebellious ores, extracting, E. C. Broadwell 753,822
Golf club, J. G. Curtiss 753,677
Golf player's scoring device, W. H. Weissbrod 753,457
Grain binders, mechanical movement adapted to, W. C. Duryea 753,559
Grate and flue therefor, A. L. Houston 753,263
Grinding or crushing apparatus, T. Breakell 753,537
Guide roller, W. H. Stobie 753,753
Gun sight, Meigs & Jakobsson 753,505
Hair crimper, J. F. Martin 753,416
Hammer, pneumatic, C. H. Shaw 753,438
Hammer, power, J. H. Norquist 753,618
Hanger and track therefor, H. L. Ferris 753,481
Harmonica holder, O. T. Knode 753,713
Harvesting machine, E. J. Wang 753,768
Hat fastener, H. V. Rickard 753,314
Hat napping machine, M. H. Nein 753,804
Hay loader, A. W. Bailey 753,219
Heating buildings or dwellings, system of, L. M. Gates 753,253
Heating system, steam, J. R. Shanklin 753,324
Heddle bar or support clamping device, J. C. Edwards 753,380
Heel for boots or shoes, detachable, F. F. Anderson 753,532
Hinge, card table, H. F. Keil 753,710
Hinge, self-locking, N. J. St. Hilaire 753,443
Hoe and plant fender, adjustable, H. Lemm 753,830
Horseshoe, O. Schramm 753,638

Horseshoe, J. F. Clark	753,668
Hose, R. B. Calcutt	753,230
Hose nozzle, C. L. Sankey	753,634
Hub guard, wheel, J. B. Howard	753,264
Hydrocarbon burner, L. E. Coleman	753,825
Hydrocarbon vapor engine, Tuck & Wassmann	753,331
Ice cream freezer, J. P. Perkins	753,622
Ice cutting machine, H. Reinhold	753,519
Index, B. G. Chappee	753,546
Indicator, Kellogg & Brady	753,798
Insulated pipe joint, W. A. Learned	753,595
Jacquard machine, W. Cochran	753,547
Jewelry clasp, C. E. Hansen	753,486
Journal, W. P. Deppe	753,242
Journal box lid locking device, L. R. Dewey	753,682
Knife or fork cleaner, E. F. McDonough	753,609
Knit fabrics, mechanism for transversely severing webs of, F. G. Shelain	753,812
Knitting machine, B. T. Steber	753,645
Knitting machine, I. W. Lamb	753,715
Knitting machine pattern switch, E. A. Hirner	753,260
Label, J. A. Dawson	753,371
Ladle, J. M. Nyce	753,728
Lamp burner, H. L. Bowlin	753,352
Lamp burner attachment, E. Krebs	753,405
Lamp, coke drawer's, J. S. Snyder	753,748
Lamp socket, D. A. Schutt	753,321
Lamp socket and plug, D. A. Kimbark	753,276
Latch, gate, W. A. Sebring	753,323
Lathe, wheel, J. R. Crowley	753,675
Letter and document distributer, F. Bristow	753,538
Life saving apparatus, means for lowering loads applicable as, C. Klarle	753,499
Lighting attachment, J. H. Prosser	753,517
Lightning arrester, H. N. Keifer	753,582
Linotype machine matrix, W. G. Middleton	753,604
Lock. See Door lock.	
Lock, H. Bryda	753,667
Lock and latch, combined, J. E. Young	753,783
Locket, A. Y. Cunningham	753,473
Locomotive weed destroying attachment, E. M. McCoy	753,608
Loom picker check, J. M. Peckham	753,515
Loom power shipping and brake mechanism, A. R. Patten	753,807
Loom shedding mechanism, A. R. Patten	753,808
Loom shuttle, C. B. Webster	753,337
Loom, swivel, C. Schoen	753,521
Loom, swivel, E. H. Ryon	753,741
Mail bag catcher, W. D. McClellan	753,288
Mail bag crane, M. Lally	753,501
Mail box, M. L. Ogle	753,302
Mail box, G. W. Smith	753,523
Mantle support, T. Stites	753,328
Mariners, artificial horizon for use of, J. M. Stratton	753,445
Marking device, fountain, J. E. Langill	753,593
Marking machine, E. M. Schantz	753,435
Match box filling machine, H. Beeg	753,223
Match receptacle, J. E. Neahr	753,297
Measuring apparatus, liquid, T. E. Mather	753,283
Measuring instrument, light, Millard & Palmer	753,508
Mechanical movement, B. Hall	753,389
Megaphone, F. E. Mitchell	753,417
Memorandum for household use, permanent, A. R. Mensing	753,601
Metal cutting shears, C. F. Deitrick	753,681
Metallurgical furnace, F. Kepp	753,712
Milk cooler, J. & M. Hadaller	753,699
Milk, etc., treating, A. Gaulin	753,792
Mirror or other toilet article, hand, J. C. Dowd	753,476
Mixing and kneading machine, E. W. Osburn	753,621
Molder's flask, M. A. Clapp	753,471
Monkey wrench, E. F. Howard	753,396
Motor, I. H. Spencer	753,644
Mowing machine, J. T. Gillaspy	753,697
Music leaf turner, J. W. Taylor	753,758
Musical instrument automatic playing apparatus, Powers & Jewell	753,809
Nursing appliance, A. S. Dixon	753,683
Nut lock, N. Jamison	753,273
Nut lock, W. H. Mack	753,415
Nut lock, W. L. Durden	753,686
Nut lock, F. Obiols	753,301
Nut, lock, A. L. Mowry	753,421
Oil can, non-explosive, Gray & Lehmann, reissue	12,201
Ornament, Wundsch & Lange	753,781
Ornamental articles, holder for forming, A. A. von Renthe-Fink	753,629
Overflow alarm, E. A. Reeves	753,518
Package and closure therefor, R. S. Case	753,543
Package fastener, D. J. McLean	753,727
Packing case or crate, Wilson & Baker	753,342
Packing, metallic, E. James	753,494
Packing, metallic, H. Roberts	753,810
Packing, rod, F. Pinch	753,731
Pad holder, French & Decker	753,693
Paddle wheel, T. J. Campbell	753,358
Panel, C. Shepherd	753,641
Paper stock, machine for working old, W. Burke	753,540
Paper winding machine, G. S. Witham	753,344
Pendulum, J. W. Daily	753,475
Penholder, R. B. McBee	753,607
Photographic printing apparatus, White & Mallison	753,455
Piano key attachment, H. S. Strauss	753,756
Picture hanger, H. Minck	753,605
Pipe connections, apparatus for tightening socket, H. Beinhauer	753,464
Pipe wrench, G. McKercher	753,725
Pipes, cleaning and coating, J. G. McDowell	753,610
Pistons, machine having rotating, C. H. O. Hamann	753,390
Planter seeding attachment, corn, G. P. Oates	753,729
Pliers, W. A. Bernard	753,224
Pliers jaws, W. G. G. Weidinger	753,456
Plow, G. L. Bradley	753,468
Plow, G. L. Edgerton	753,478
Plow harrow attachment, J. Scherer	753,635
Plumb and level, G. C. Brown	753,354
Plumb and level, C. H. Craven	753,551
Pole, carriage, J. McIntosh	753,423
Pole or post base, G. H. Jones	753,709
Post. See Fence post.	
Press, M. Brown	753,539
Presses or the like, fluid system for, W. M. Holmes	753,261
Printer's chase attachment, L. G. Couly	753,671
Printing and folding machine, W. Scott	753,640
Printing apparatus, rotary stencil, S. Brown	753,469
Printing block, W. M. Rochstroh	753,740
Printing forms on cylindrical surfaces, producing intaglio, G. F. & J. W. McIndoe	753,290, 753,291
Printing, planographic, G. R. Cornwall	753,368
Printing, preparing color plates for, C. N. Smith	753,746
Projectile, J. R. Jacobs	753,272
Projectile, explosive, Meigs & Gathmann	753,504
Propeller, fish tail, Z. von Limbeck	753,717
Pump, A. J. Miksch	753,507
Pump, F. E. Ten Eyck	753,530
Pump, J. Hahn	753,828
Pump driving mechanism, J. C. Whitmer	753,771
Pump, power, H. M. Chase	753,361
Pump, steam, F. B. Corey	753,367
Pump, vertical plunger sinking, E. M. Coryell	753,550
Puzzle, O. L. Hubbard	753,266
Puzzle, G. L. Mott	753,420
Puzzle, D. L. Munro	753,831
Puzzle lock, H. Bruck	753,355
Rack, C. D. Lyon	753,598
Rail joint, P. Holbrook	753,395
Rail joint, B. C. Rowell	753,434
Rail joint, J. M. Staples	753,441
Rail joint, W. C. Burgum	753,470
Rails, renewing traction, D. H. Lentz	753,409
Railway crosstie, Lecking & Hartman	753,502
Railway gate, automatic, C. W. Curd	753,676
Railway signal, T. Bruck	753,666
Railway tie and chair, J. J. Phillips	753,307
Railway trains, system for preventing collisions, accidents, etc., by, F. Schmidt	753,636
Railways and switching systems embodying same, combined third and traction rail for electric, E. C. Morgan	753,802
Railways, combined third and traction rail for electric, E. C. Morgan	753,803
Railways, contact device for electrically-propelled, H. Berthoud	753,536

Ram, hydraulic, Earle & Shainline ... 753,560
Refrigerator, F. M. Vanneman ... 753,764
Refrigerator drip pan alarm, S. S. Lapointe ... 753,799
Register, J. O. Morris ... 753,418
Register, F. R. Beal ... 753,535
Rheostat, J. C. Barclay ... 753,533
Rivet setting machine, A. T. Maenche ... 753,281
Road making and repairing machine, A. Cameron ... 753,231
Road making and repairing machine, J. Krohn ... 753,277
Rolling mill, D. H. Lentz ... 753,408
Rope grab, J. Carney ... 753,233
Rotary engine, J. J. Horan ... 753,262
Rotary engine, A. Groves, Sr. ... 753,388
Rotary engine, T. D., J. C., & H. A. Prescott ... 753,735
Rotary engine, F. P. & B. F. Uhrig ... 753,763
Rotary engine, A. F. Ford ... 753,790
Saddle, riding, P. R. Stern ... 753,751
Salt receptacle, C. E. Long ... 753,597
Salve, making a, J. F. Huefner ... 753,267
Sand bars, means for removing, E. H. Allman ... 753,217
Saw filer, J. M. Holladay ... 753,575
Saw swaging and filing gage, S. J. Galloway ... 753,565
Sawing mining timbers, machine for, D. W. Edwards ... 753,688
Scale, price or money weight, A. R. Beal ... 753,222
Scissors swage, R. Miller ... 753,723
Screen. See Window screen.
Screw or bolt head lock, G. W. Kennard ... 753,403
Screw thread trimming tool, W. E. Corkrey ... 753,826
Seal, bottle, W. S. Dorman ... 753,245
Seam ripper, M. J. Bacon ... 753,655
Seating bench, J. C. Wolf ... 753,778
Seed delinter, cotton, R. Derdeyn ... 753,373
Separating lump material, A. Langerfeld ... 753,591
Separator, T. H. Ray ... 753,313
Separator, A. Langerfeld ... 753,592
Setting machine, E. L. Pupke ... 753,431
Shaft coupling, D. S. Sinclair ... 753,439
Sharpening device, F. S. Rich ... 753,630
Sheet metal can, A. T. Kates ... 753,581
Shelf structure, knockdown expansible, A. Dannenberg ... 753,678
Shingle holder, I. D. Adams ... 753,531
Shipping device, controlled, J. O. McKean ... 753,724
Shock former, J. F. Wheeler ... 753,770
Shoe, C. K. Sharood ... 753,745
Shoe fastener, G. W. Wise ... 753,776
Show case, Baker & French ... 753,656
Sight, telescopic, E. M. Hewlett ... 753,574
Sign and bird house, combined, I. Mason ... 753,599
Sled, bob, J. H. Anderson ... 753,654
Small arm, recoil loading, G. Luger ... 753,414
Smoke consuming furnace, J. H. Hawke ... 753,259
Smokeless boiler, E. Chaquette ... 753,360
Soap molding apparatus, F. C. Ihrer et al. ... 753,706
Soda water apparatus, C. A. Geddes ... 753,566
Soda water apparatus, F. H. Lippincott ... 753,718
Spectacle temple, O. Lavallee ... 753,594
Speed changer hanger, Lees & Aiken ... 753,406
Spike puller, F. W. Gerlach et al ... 753,386
Spinning or twisting machine thread guide support, L. T. Houghton ... 753,577
Spout, E. C. Staudinger ... 753,750
Spraying spar, W. H. Owen ... 753,730
Spring clip, G. W. McGill .753,611, 753,613 753,614
Stamp mill, W. A. Merralls ... 753,612
Stave shaping machine, A. L. Shaw ... 753,522
Stay bolt, flexible, J. B. Tate ... 753,329
Steam, apparatus for supplying cities with, W. C. Andrews ... 753,817
Steam or gas engine, O. B. Thorson ... 753,647
Steam, superheating, S. A. Reeve ... 753,738
Steam trap, C. A. Dunham ... 753,557
Steel concrete construction, etc., J. S. Metcalf ... 753,603
Steering gear, H. W. Hoover ... 753,576
Stone sawing machine, G. D. Hunter 753,268 to 753,270
Stove frame, vapor, I. Kinsey ... 753,498
Stovepipe fastener, E. Hanmer ... 753,701
Stringed instrument plectrum, D. W. Barnes 753,534
Stringed instrument tuning attachment, E. Sprotte ... 753,327
Stuffing box, W. T. Giles ... 753,567
Superheating system, S. A. Reeve ... 753,433
Swing fan attachment, J. E. Welin ... 753,832
Swing, lawn, C. G. & H. H. McLaughlin ... 753,726
Talking machine sound box, E. R. Johnson ... 753,274
Tank filling alarm, C. Maul ... 753,600
Tap, bottle, J. A. Sherrard, reissue ... 12,200
Teaching device, penmanship, F. C. Young ... 753,782
Telegraph apparatus, electric, A. Falcone ... 753,690
Telephone, S. C. Houghton ... 753,493
Telephone instrument, portable or table, L. M. Ericsson ... 753,563
Telephone jack field, L. M. Ericsson ... 753,562
Telephone or microphone casing, P. Hardegen ... 753,391
Telephone repeater, M. Gally ... 753,252
Telephone toll apparatus, G. A. Long, 753,411, 753,412
Textile webs, machinery for the production of, W. G. Stewart ... 753,752
Thermometer case, P. C. Kellett ... 753,711
Thill or tongue support, L. A. Scidmore ... 753,742
Thresher and separator, P. Hofmann ... 753,705
Threshing machine, J. A. Beam ... 753,350
Ticket holding device, J. J. McGuirk ... 753,514
Tie. See Railway tie.
Tile and tile setting, J. H. Munro ... 753,287
Tire inflating apparatus, E. Girard ... 753,568
Tire making machine, pneumatic, U. P. Smith ... 753,813
Tire, vehicle, H. E. Irwin ... 753,401
Tire, vehicle wheel, H. A. Palmer ... 753,426
Tire, vehicle wheel, J. A. Swinehart ... 753,646
Tires, apparatus for the manufacture of vehicle, M. Nirdlinger ... 753,300
Toilet kit, A. M. Schneider ... 753,520
Tongs or clamp, P. A. Orth ... 753,620
Tool handle, I. S. Davidson ... 753,241
Torpedo fork, Frank & Storer ... 753,692
Toy, A. P. Ward ... 753,355
Track sanding device, J. H. Hanlon ... 753,794
Traction strap, H. P. Maxim ... 753,285
Train order and signaling system, electric, J. C. Gleason ... 753,387
Trolley, A. C. Calderwood ... 753,542
Trolley, A. S. Deem ... 753,554
Trolley automatic releasing device, safety, A. C. Wolfe ... 753,345
Trolley, electric car, W. A. Daggett ... 753,552
Trolley replacer, F. A. Nolan ... 753,617
Truck, W. G. Price ... 753,627
Truck, car, W. G. Price ... 753,626
Truck, rocker side bearing, J. C. Wands ... 753,766
Truck, roller side bearing, J. C. Wands ... 753,767
Trunk, wardrobe, A. D. Seaman ..753,743, 753,744
Truss for ruptures, B. J. Douds ... 753,684
Turbine governing means, elastic fluid, J. Wilkinson ... 753,774
Turbine governing mechanism, J. Wilkinson ... 753,772, 753,773
Turbine supply nozzle, C. Weichelt ... 753,769
Twisting frame stop motion, C. Whitaker ... 753,338
Typewriter aliner, J. Alexander ... 753,651
Typewriter alining mechanism, J. Alexander 753,348
Typewriter, polychrome, Joerissen & Livingston ... 753,797
Typewriter type bar segment, C. W. Howell, Jr. ... 753,397
Typewriting and tabulating machine, Jarvis & Blakeslee ... 753,796
Typewriting machine, Dukes & Clayton ... 753,788
Typewriting machine, stenographic, A. Saliger ... 753,318
Typewriting machines, work handling mechanism for, Dukes & Clayton ... 753,789
Upholstering, casket, A. J. Cross ... 753,674
Valve, C. L. Turner ... 753,332
Valve, cam movement, C. Rogers ... 753,631
Valve, combined steam and water, Parker & Castleberry ... 753,427
Valve reseating machine, gate, F. L. Smith 753,747
Valve seat planer, portable, W. H. Bean ... 753,786
Valve, W. H. Stratton ... 753,755
Variator, W. C. Andrews ... 753,754
Vehicle body loop, L. Crise ... 753,472
Vehicle driving and steering mechanism, motor, E. L. Russell ... 753,317
Vehicle, electrically propelled, H. P. Maxim 753,284
Vehicle, motor, W. J. and G. Lane ..753,589, 753,590
Vehicle spring wheel, Ramage & Macmillan 753,432
Vehicle steering connection, motor, E. L. Russell ... 753,316
Vehicle step attachment, J. M. Vaughan ... 753,394

Velocipedes or road motor vehicles, variable gearing for, J. Archer 753,785
Velocity meter, G. Dettmar 753,243
Vending machine, Caldwell & Martin 753,824
Voting table and ballot box, L. W. Sprague 753,536
Wagon body, folding, F. H. McMurray 753,282
Wagon box fastener, W. H. Dulaney 753,278
Wagon brake, H. H. Piper 753,732, 753,733
Wagon, coal, A. C. Pannepacker 753,806
Wagon, dumping, A. Cameron 753,238
Wagon, speed, J. P. Faber 753,689
Wardrobe and bed, combined, S. Austin 753,462
Wardrobe, folding, J. F. Hayes 753,393
Wardrobe, portable, Magul & Cooper 753,721
Washstand, T. Widdop 753,339
Washer, D. Kunkle 753,588
Watch holder, A. M. & E. S. Church 753,363
Watch mainspring, E. F. O. Klein 753,584
Waterway, pleasure, A. Pusteria 753,311
Weeder tooth, E. G. & A. E. Quickel 753,312
Weighing machine, E. H. Cook 753,548
Welding apparatus, H. Dicke 753,375
Well drilling machine, D. W. Saunders 753,319
Wheels. See Burnishing wheel.
Wheel guard, J. B. Howard 753,265
Whiffletree hook, C. E. Jones 753,708
Wick, lamp, A. H. Nelson 753,299
Windmill, C. A. Wright 753,400
Windmill, W. A. Butler 753,541
Window, G. Kabureck 753,579
Window, H. E. Brown 753,665
Window adjusting device, A. F. Enquist 753,479
Window, antiheat radiating, Voigtmann & Pomeroy 753,765
Window frame or sash, H. Romunder 753,315
Window screen, W. B. Cochran, Jr. 753,238
Window screen, W. A. Cassidy 753,544
Woven fabric, C. H. L. Hanson 753,702
Wrapping machine, package, D. F. Bremner, Jr. 753,661
Wrench, A. De Vilbiss, Jr. 753,374
Wrench, F. D. Harris 753,703
Wrench, A. Magnuson 753,720
Yarn guide holding mechanism, J. E. Prest. 753,625

DESIGNS.

Cash registering cabinet or casing, E. Ringold 36,831
Chain, watch, J. Hams 36,825
Dish, J. Maddock 36,830
Monument, E. M. Wolff 36,832
Spoons, forks, or similar articles, handle for, E. Crees and C. S. Court. 36,826 to 36,828
Tableware, open work border for metallic, A. Steffin 36,829

TRADE MARKS.

Belting, Jewell Belting Co. 42,163
Canned and bottled fruits and vegetables, S. Hamill Company 42,180
Chemicals, certain named, C. Jager 42,175
Chocolates, Societe Anonyme des Chocolats au Lait F. L. Cailler 42,179
Compound for prevention and cure of sweating of the axilla, N. D. Richards 42,173
Cotton piece goods, G. Willis & Co. 42,161
Disinfectants and disease preventives, Immunene Mfg. Co. 42,165
Disinfectants, germicides, and deodorizers, R. W. Carle 42,166
Extracts and essences, Iowa Medicine Co. 42,177
Flour, wheat, Washburn, Crosby Co. 42,181, 42,182
Foundry facings, J. S. McCormick Co., 42,185, 42,186
Horse nails, Capewell Horse Nail Co. 42,190
Horse nails, blued, Capewell Horse Nail Co. 42,191
Leather polish, Whittemore Bros. & Co. 42,183
Linings, Burton Bros. & Co. 42,159, 42,160
Lotion for cure of certain named diseases, Brown & Allen 42,172
Lozenges or throat tablets, bronchial, L. J. Gerson 42,167
Lubricants soluble in water, Fuller & Jones 42,184
Medicine for certain named diseases, liquid, S. R. Burford 42,168
Napkins, sanitary, Seabury & Johnson 42,174
Paper and envelops, writing, F. J. Marshall 42,164
Powder books, paper, A. S. Butler 42,171
Razor strops, Weiffenbach Mfg. Co. 42,189
Razors, safety, Reichard & Scheuber Mfg. Co. 42,187, 42,188
Remedy for expelling worms from the system, Lanman & Kemp 42,169
Shades and shade fabrics, window, B. Price 42,157
Suspenders, men's, L. Oppenheimer's Sons. 42,158
Thread, sewing, Jonas Brook & Bros. 42,162
Whisky, George Ballantine & Son 42,176
Witch hazel or hamamelis, extract of, Lanman & Kemp 42,170

LABELS.

"Bald Eagle," for axes and edge tools, Mann Edge Tool Co. 10,797
"Boneset and Wild Cherry Expectorant," for medicine, R. Burkhardt 10,783
"Colonial," for axes and edge tools, Mann Edge Tool Co. 10,796
"Crown," for creamery butter, F. H. Arnsburger 10,787
"Fifteen Years Old Manassas 1861 Pure Rye Whisky," for whisky, P. McIntyre 10,791
"Grippura (Germ Destroyer)," for a medicine, A. Crichton 10,784
"Hedeval," for hog cholera cure, American Hog Cholera Cure Co. 10,786
"John Lord," for cigars, Grand Rapids Cigar Box Co. 10,792
"Khedive," for tea, Milliken, Tomlinson Co. 10,789
"Mann's Superior," for axes, J. H. Mann.. 10,794
"Marsalina the 20th Century Hair & Skin Tonic," for a toilet preparation, J. M. Aboussleman 10,781
"Nigridine," for medicine, F. C. Reighter.. 10,785
"Persian Rose Pomade," for a toilet preparation, J. M. Aboussleman 10,782
"Red Top," for axes and edge tools, Mann Edge Tool Co. 10,798
"Roelefette," for hats, H. I. Ireland 10,780
"Scale Off Boiler Compound," for boiler compound powder, Howard Chemical Co. 10,793
"Shamrock," for tea, Milliken, Tomlinson Co. 10,790
"The Sentry Box," for newspaper articles, C. W. Post 10,779
"The XX Axe," for axes and edge tools, Mann Edge Tool Co. 10,795
"Underwood Sugar Cured Meats," for canned and other meats, Omaha Packing Co. 10,788

PRINTS.

"Athlophoros," for medicine, Athlophoros Co. 913
"Bicycle Playing Cards, New Automobile Designs," for playing cards, United States Playing Card Co. 908, 909
"Eyelene," for medicine, G. W. Wise 914
"Gold Band Ham and Bacon," for ham and bacon, Armour Packing Co. 911
"Overcoat Fashions for Spring," for men's spring apparel, David Adler & Sons Clothing Co. 910
"Plant of Modern Automatic Can Making Machinery," for can making machinery, T. Wold 907
"The Flour Barrel of the World," for flour, D. M. McLean 912

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.